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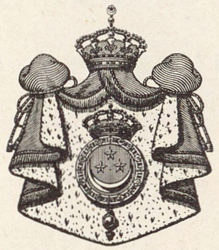
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1941

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THE PLACE OF EGYPT IN PREHISTORY

A CORRELATED STUDY OF CLIMATES AND CULTURES IN THE OLD WORLD

BY

S. A. HUZAYYIN

(FUAD I UNIVERSITY, CAIRO)

With a Foreword by Prof. H. J. FLEURE, D. Sc.

CAIRO, 1941.

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إلى أرض مصر الطيبة

To

The Good Land of Egypt

FOREWORD

BY

PROFESSOR H. J. FLEURE, D. Sc.

It is now a commonplace that Charles Darwin effected a revolution in the world's thought extending far beyond the field of natural science. It is not always so clearly recognised that one of his most fundamental concepts was that of the endless chain of actions and reactions between living things and their environments, both being subject to changes and each in its turn influencing the other. This idea of studying life and environment together must be increasingly applied in research upon man both physically and culturally. In studying mankind, especially, the environment and the people must both be envisaged, and it is particularly important to remember that the environment varies both through human influence upon it and because of such factors as the phases of radium decomposition in the earth's interior and the phases of solar irradiation of the earth. It is probable that periods of minimal solar irradiation in summer time help to produce Ice Ages when they coïncide with some phase of the mountain building cycle as studied by Joly and his successors. Milankovitch has calculated on astronomical data the periods of such minimal summer irradiation in the last million years and it appears that the results give a possibility of agreement with archaeological and geological conclusions

based upon the study of moraines, solifluxions and river terrace deposits.

The study of environments in the days of early man brings out evermore clearly the great importance of North Africa and the Sahara-Arabia belt at that time, and Dr Huzayyin's study is of special interest on that account. He has tried to weave together data of changing physiography, changing climates, changing vegetation, changing cultures and communications. His is one of the first efforts of a really comprehensive character relating to what is now the desert zone, and it forms a useful basis for discussion; its hypotheses will stimulate thought and fresh observations; its conclusions may need modification as knowledge grows. It is a special pleasure to note that this patient and careful synthesis relating to the Old World in general and the Sahara and Egypt in particular is the work of an Egyptian student. May it be the herald of many more efforts by the scholars of modern Egypt to interpret their country's position in the world, past, present and to come, and to win for Egypt the ever fuller recognition of her learning.

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PAGE	LINE	FROM ABOVE	FROM BELOW
5	14	trias *read* Trias	
5	14	cretaceous *read* Cretaceous	
12	5		Hemisphered *read* Hemispheres
12	1		Antartica *read* Antarctica
13	11	N. W. Europe *read* N. Europe	
18	1		(1828) *read* (1928)
23	8	Telegen *read* Tegelen	
23	10	*stenonsis* read *stenonis*	
27	12 and 15		G. S. Simpson *read* G. C. Simpson
29	7	Tale *read* Table	
34	7		Tamarelli *read* Taramelli
38	2		G. P. Wright *read* G. F. Wright
45	6		Latitude *read* Latitudes
47	15		Terraces *read* terraces
50	13	Sicilain *read* Sicilian	
64	17		wart hog *read* wart-hog
65	4	*Antiquus* read *antiquus*	
81	14	(Sabilian) *read* (Sabylian)	
82	4		ʿAbbasiyyah *read* ʿAbbasyyah
90	15		Passmard *read* Passemard
101	9	world *read* would	
109	25		Pre-Sabilian *read* Pre-Sabylian
117	11		Dandar *read* Dindar
123	13		South *read* south
150	8		El-Fashn *read* al-Fashn
157	17	eorrespond *read* correspond	
163	1		abont *read* about
169	2	*stemonis* read *stenonis*	
172	7	*The Question... etc.*, Cap., not Itallics	
208	4		(Harrar) *read* (Harar)
217	14		add : (*and N. W. Africa*)
223	2		Achmolean *read* Ashmolean
224	21	Africain *read* African	

PAGE	LINE	FROM ABOVE	FROM BELOW
240	3	Early *read* early	
241	5		Vanfrey *read* Vaufrey
258	12		Levallo isand *read* Levallois and
290	9		*add* following sub-title : *"Eneolithic" Industries of Palestine.*
292	6	"Group" *read* "group"	
319	6	early *read* Early	
347	11	Openheim *read* Oppenheim	
352	22	Baumgartel *read* Baumgärtel	
357			*add* Cooke H. B. S. etc., *see* p. 406
358			*add* Dalloni, M. etc., *see* p. 406
362	16		Fewkes, G. J. *read* Fewkes, V. J.
363			*add* Fleury, E. etc., *see* p. 406
367	16		Germanov *read* Gerasimov
376	11	Brevil *read* Breuil	
377	9	(1927 *a*) *read* (1927)	
379			*place* Macalister etc. *before* MacCurdy etc.
388	16	Peterson *read* Paterson	
393			*add* Riet Lowe, C. van etc. *see* p. 406
393	12		Richtopen *read* Richtofen
398			*add* Speiser, E. A. etc. *see* p. 406
398	2		*Handbueh* read *Handbuch*
399	4		Tatamelli *read* Taramelli
400			*add* Todd K. R. U. etc., *see* p. 406
424	2		Qurnah(?) region *read* Qurnah region
428	1		*add* : In 1941, Pilot Officer R. Grace has also discovered a gravel-spread (perhaps remains of a dissected terrace?) in the Heliopolis aerodrome area (N. of Cairo), which yielded a very similar industry (or perhaps a slightly earlier facies of it).
432	5		*add* : *N. B.* The date of these specimens, however, is not certain.
440	8		layer *read* level

INTRODUCTION.

THE METHODS AND SCOPE OF TREATMENT.

The study of prehistoric societies and cultures has recently been engaging the attention of students from various fields of work. In particular, the subject has been approached from two main points of view : the archaeological and the ethnographic. In the former case, the industries are usually studied and classified on an essentially technological basis. Similarities and connections between the various facies are usually taken to represent more or less definite relationships, except in very special cases when independent discovery and parallel evolution are admissible. The ethnographical approach to prehistory differs from the purely archaeological one in the fact that it takes the present day conditions among the *so-called* "primitive societies" as to some extent a guide to the study of prehistoric groups. In many cases, however, the archaeological and the ethnographic methods have been combined in an attempt to gain a more thorough understanding of the cultural and social groupings of prehistoric societies. To these methods are usually added—in a secondary way—evidences drawn from physiography, palaeontology (animal and human), etc. Very recently, however, the conception that a geographical approach to prehistory may not be entirely without value, has been coming to the front. The only serious trouble

arising from this was the fact that the domain and scope of a geographical treatment were not always easy to define. The current view about modern geography as a science is that it brings together the "geographical aspects" of many sciences dealing with nature (*e.g.* geology, climatology, botany, etc.) on the one hand, and man (ethnography, sociology, etc.) on the other. It is therefore regarded as a synthesis which gives a common picture of the *milieu* and *man* that no other of the above mentioned "primary" sciences (which it utilizes) can give of itself. In this respect, geography is somewhat similar in nature to philosophy. But the difference is that while philosophy can also be used in an analytical as well as a synthetic treatment, geography does not go beyond synthesis. In very recent years, however, an attempt has been made to carry geography further. It is argued that if geography aims at synthesis alone it must become unprogressive and stagnant. If, on the other hand, this synthetic science can be converted into a "primary" one, *i.e.* if geographical principles and methods of approach can be used as helping elements in analytical treatments by other adjoining sciences, stagnation can be avoided and a closer parallel with philosophy can be drawn. Geography would be then like a connecting link, which brings together the geographical aspects of various cognate sciences, moulds them into a synthetic whole, and then re-diffuses them (as a "primary" element) into the same or other sciences connected with detailed aspects of the interrelation between *nature* and *man*. The experiment of diffusing geographical knowledge and methods into adjoining sciences has been carried out (more especially in the domain of anthropology, both physical and social) by H. J. Fleure, S. De Geer

and a number of other workers. The result of the experiment hardly needs comment here. The same experiment may be extended into the domains of proto-history and prehistory, perhaps not with less successful results. Indeed the present work is primarily intended as a continuation of these experiments, especially in dealing with the Palaeolithic phase of the human story. It will be its main theme, first to attempt to reconstruct—in their main outline, and in so far as warranted by the available data—the geographical conditions on the stage or stages of the successive phases of prehistoric times in the western half of the Old World (with special reference to the Saharo-Arabian Area and Egypt), and then to treat the culture complexes of these phases in their geographical setting. Of course this is much too ambitious a scheme; but apart from certain points of detail, we shall aim principally at sketching the geographical aspect of the story. In short, this treatment is intended primarily as an *experiment* in the study of settings and distributions of prehistoric cultures.

*
* *

For purposes of convenience we have divided the work into two Parts : physiographic and technological. In the first Part we shall study the climatic changes—as they may be gleaned from geological, stratigraphical and bio-geographical evidence—over the regions studied. This is necessary in order to gain a clear view of the conditions prevailing on the stage of the human drama of prehistoric times. It also helps to determine more precisely the part played by the Saharo-Arabian Area, and more particularly by Egypt,

in the sequence of prehistoric cultures. In dealing with the climatic changes it has been found safer to start with the most recent phases (proto-historic times) and proceed backwards to the end of the Pliocene. This is of course a hazardous course; but in following it we are proceeding from phases the records of which are best preserved to those about whose details we know relatively less. This procedure also provides us with a more definite and secure starting point, as geologists are not agreed amongst themselves as to when the Pleistocene started, or even whether it started at exactly the same time in different parts of the world [1].

Our study in this physiographic Part aims ultimately at attempting to establish climatic correlations between different latitudes in the Old World. The conclusions arrived at here are not based so much on a pre-conceived theory or group of theories, as on deduction and inference from a synthetic and comparative review of the physiographic data available. It is evident, however, that the time is still far from ripe for establishing *definite* and *detailed* world-wide correlations; and that consequently, the Tables we have constructed can only represent *preliminary* and *broad* attempts. It was thought useful to start, at the present stage, with a *tentative* co-ordination of the data available, in the hope that such a co-ordination might help

[1] In order to avoid this difficulty, geologists often resort to the somewhat less definite term of "Quaternary", which is recommended whenever vagueness of date is advisable. This term will be used here (rather vaguely in many places) as synonymous with Pleistocene, but also including the transition phases from the Pliocene into the Pleistocene and from this latter into the Recent (but also *vide infra*, pp. 147-149).

in clearing up the way for more definite correlations when time and material allow. Our conclusions must, at any rate, remain subject to correction and modification, as our knowledge grows.

The material embodied in this Part has been collected largely from various references, though a certain amount of field-work was also carried out on certain Quaternary formations in W. and Central Europe, as well as in Egypt and S. W. Arabia.

The second Part of the work deals with the archaeological and cultural sides. It is divided into three Sections consecrated to (i) the L. and Mid. Palaeolithic, (ii) the Upper and Final Palaeolithic and (iii) the Neolithic and so-called Post-Neolithic (Chalcolithic) respectively. Some detail is given on the technological evolution of the main industries concerned; but, as already mentioned, the main object of the treatment is the geographical setting of the cultures and the significance of their distribution. Special reference is of course made to the rôle of the Saharo-Arabian Area, and more particularly to the place of Egypt, in the culture story of the Old World. The last Section is entirely devoted to the Neolithic and Post-Neolithic of the latter country and its approaches.

As will be seen, the conclusions arrived at in the three Sections are not always compatible with current views regarding settings, distributions, sequence or chronology of prehistoric cultures in different parts of the Old World. It goes without saying that the present writer cannot claim to express expert views on many of the topics outlined here; but it is hoped that enough technological detail has been put forward to provide a working basis for argument. Several, perhaps many, of the views expressed here will have to undergo

modification as archaeological material accumulates. As is known, conclusions relating to prehistoric archaeology are liable to undergo rapid changes as fresh discoveries are made. But if our conclusions (especially Maps 1-3) could stand the test, and provide a basis for discussion, during a single decade, or so, they will have more than amply fulfilled their modest end [1].

In pursuing our argument, however, we did not deem it necessary to give here explanatory accounts of the main industries and facies representing the basic elements in lithic technology. Nor did we include a description of the principal tool-types that characterise the *chief* industries (*e. g.* Chellean, Acheulean, etc.). Details of this kind could be more readily obtained in any of the standing books on prehistory. Similarly, the illustrations included in our plates are intended only to bear out certain arguments followed in the text. They do not illustrate the whole sequence of lithic industries. Some of the drawings were originally made by the writer for ordinary study purposes, and so they may perhaps lack absolute accuracy of detail.

The material embodied in this second Part has not been all collected from works on the subject. A fair amount of it is based on the study of stone implements and other remains from various parts of the world in over twenty-five different Museums, Institutes and

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[1] The writer will be very grateful indeed to those readers who will be so kind as to bring to his notice the discovery of any material that may affect some of his conclusions. Also reprints of papers (whether physiographic or archaeological) will be very much appreciated, as these are not always easily obtainable. Permanent address as follows : Section of Geography, Faculty of Arts, Fuad I University, Cairo, Egypt.

private collections. The following may be mentioned in particular : al-Mat-haf al-Misri (Egyptian Museum, Cairo); Mat-haf al-Djami'ah (Geography Section or Department, Fuad I University, Cairo); Deutsches Institut für aegyptische Altertumskunde, Cairo; Institut de Paléontologie humaine, Paris; Musée de l'Homme (*ex*-Musée ethnographique du Trocadéro), Paris; the British Museum, London; University College, London; Karl Pearson Museum (now removed to the Institute of Archaeology, St John's Lodge, Regent's Park), London; the University Museum, Manchester; the Museum of Archaeology and Ethnology, Cambridge; the Ashmolean and Pitt-Rivers Museums, Oxford; Museum für Völkerkunde (Vorgesch. und Afrik. Abteilungen), Berlin; Kunsthistorisches Mus. und Naturhistorisches Mus., Vienna; Nationalmuseet, Copenhagen; Musèo dell'Università, Rome; National Museum, Warsaw; P. Bovier-Lapierre Collection (Collège des Jésuites), Cairo; O. Menghin Collection (Urgeschichtliches Institut), Vienna; Harper Kelley Collection (Laboratoire d'Anthropologie), Paris, etc. To all these Museums, Institutes and individuals the writer is deeply indebted not only for the possibility of work on the material (in many cases unpublished), but also for permission to make drawings (or photographs) and include some of them in the present work. In this connection, sincere thanks are also due to certain individuals, whose recent discoveries in Egypt have been fully made use of in our work. These include Misses G. Caton-Thompson and E. W. Gardner, Drs K. S. Sandford and J. W. Arkell, Profs. H. Junker, O. Menghin and M. Amer, G. Brunton, O. H. Myres, Pilot Officer R. Grace, the late Col. Statham, etc. With G. Caton-Thompson and E. W. Gardner, I have also had

the pleasure of co-operating in field work and in a previous publication. Their particularly kind and encouraging help, as well as that of other individuals and authorities who have aided in one way or another have been duely recorded in the footnotes and explanatory notes accompanying our text and plates.

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In the course of the present work, it has been attempted to make the bibliographical references as complete as possible, though the Bibliography appended at the end can in no way claim to embody more than part of the literature available. Certain parts of the work have been fairly fully annotated with footnote references, while others have been only summarily documented. The rather wide scope of the treatment may be an excuse for this latter shorter treatment of some topics. For purposes of brevity, only the name of the author and the year of the publication are given in the footnotes, and these will serve as a key to the full references in the Bibliography.

The question of terminology and nomenclature offered more serious difficulties. Prehistorians are not as yet agreed amongst themselves upon this delicate question, which cannot of course be settled here. We have therefore attempted to avoid the new terminology of Prof. O. Menghin and others (though *part* of this terminology may perhaps have been preferable to the one used), and to employ the current terms of the main divisions of Palaeolithic and Neolithic cultures. We have even maintained certain current terms, which, in the light of more recent investigations, have become somewhat objectionable. The term "Chellean", for instance, has been preferred to that of

"Abbevillian", more recently proposed by H. Breuil, but not accepted by all. At the same time, however, the term "Final Palaeolithic" has been used (though not persistently) in preference to that of "Mesolithic". Also in certain regions, special (regional) denominations have been preferred to more general ones. In Egypt, for example, we have often used "Post-Neolithic" to denote the same thing as "Chalcolithic" (from Badarian to Dynastic times), while in Palestine the rather objectionable term of "Eneolithic" has been used to cover both Chalcolithic (?) and Bronze Age industries. Other difficulties regarding terminology and connotation of certain terms (especially in Egypt), have been pointed out in our footnotes. It is evident, however, that the general problem of nomenclature cannot be settled here. Until the time has come when a general agreement between prehistorians is possible, no author can do more than make clear the exact meaning and connotation of the terms he uses.

Another difficulty which also presented itself was the question of transliteration of Arabic and other place-names (and cultures derived from them). At present, transliterations often diverge from the original pronunciation, and they also vary according to whether the transliterator is English, German or French, etc. In the absence of a standard system, we have found it advisable (especially in Egyptian names) to revert to renderings which would be as near to the original pronunciation as possible. Thus we have used Fayyoum (for Fayum), Khargah (for Kharga), Sabylian (for Sebilian), etc. As a rule, however, we have added, between brackets, the more current forms at the time when the name was mentioned for the first time. But even this did not entirely eliminate difficulties, as there was often

a marked difference between the *official* and the *local* pronunciation of place-names (especially in Egypt). Moreover, it was found that in certain cases [such as Marmadah (Marmadat) or Mremdah (Mremdat) Bani Salamah, W. Delta, Egypt], a strictly correct transliteration might have been actually misleading to readers who were not acquainted with the Egyptian variety of Arabic. In such cases, it was thought wiser to maintain current forms and their derivatives (Merimde and Merimdian). Similarly we have maintained such terms as Oran (N. W. Africa) and Oranian, instead of the more correct ones of Wahran and Wahranian. But it should be made clear that on all these matters prehistorians are still in need of some kind of general agreement (applicable to various foreign languages). Until this is attained, the different forms adopted by various workers must remain largely a matter of expediency and temporary convention.

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A concluding note must be added in gratitude to those authorities and individuals who have been responsible for granting the present writer one of the Fuad I University's research allowances, for the guidance of his studies in Egypt and abroad or for making possible the publication of this work. On graduating from the Faculty of Arts, Cairo, in 1929, the writer was very kindly granted by the Egyptian (now Fuad I) University a research allowance which lasted for no less than seven years. His debt to the University, in this and many other respects, is more than can be adequately expressed in words. Of the whole period over five years were spent in research

work and training in various countries of Europe (especially England and France) and the rest in research and field work in Egypt and S. W. Arabia. In 1935, the writer was able to present a thesis for the degree of Ph. D. at the Victoria University of Manchester, for which he was also kindly granted the Langton Research Fellowship of that university. The thesis was entitled "The Place of Egypt in the Prehistory of the Old World : with special Reference to Quaternary (Diluvial) Climates and Cultures in the Saharo-Arabian Area". Since that date, the original work has been much enlarged and in several parts *re-writen* in the light of more recent data (up to 1940). The final result is now presented in book-form thanks to the gracious generosity of al-Madjmaʿ al-ʿIlmi al-Misri (Institut d'Égypte), of Cairo, whose grant covered over 90 % of the cost of publication—the rest having been contributed from the proceeds of the Langton Fellowship of Manchester University. I am very deeply indebted to these two Institutions for their kind appreciation of my work—an appreciation which even war conditions could not frustrate!

I have also received kind encouragement and guidance from many individuals in Egypt and abroad. Dr Bahî-ul-Deen Barakaat, Minister of Egyptian Education in 1930, has used his good offices in overcoming difficulties of regulations, which, if applied according to their letter, would have ruled out the possibility of my study-mission abroad—and consequently of this work in its present form. Professor Taha Husein, Dean of the Faculty of Arts (Cairo) at that time and for several years afterwards, has generously accorded me his unfailing encouragement, even at times when he was out of office. The two years during which I had previously followed his courses

(in Literary Criticism), while fresher at the University (1925-1927), have taught me much of his methods and techniques in free thought and scientific criticism—in which he was a pioneer in our naissant University. Eversince, he has followed my work with encouraging interest, and it is a pleasure to record here the debt of one of his many pupils in other fields than his own. Professors M. Amer and M. Awad of the Section of Geography, Faculty of Arts, Cairo, have also initiated me in geographical studies, and have given me the groundwork, for later years of research. I am deeply indebted to Prof. Amer, who, as the first Egyptian prehistorian, has encouraged my early interest (while undergraduate) in prehistoric studies. In later years, I have had the pleasure of co-operating with him in field excavations and the benefit of receiving his advice in my work. After the conclusion of my study-mission abroad, both Professors Amer and Awad have invariably offered every possible help for the continuation of my researches, in spite of other duties as member of the teaching staff in the Geography Department of our Faculty. I can do but hope that the present work will serve as a humble addition to their patient labours in the building up of our Department.

During the years I spent abroad, I have had the good fortune of working with Professors P. M. Roxby (Liverpool), H. J. Fleure (Manchester), H. Breuil (Paris) and O. Menghin (Vienna). With Prof. Roxby I carried out research work connected with historical rather than prehistoric geography. This was particularly useful, however, in helping me to grasp and appreciate the value of the "geographical factor" in human activity and history in general.

After that I have had the benefit of continuing my researches under the direct guidance of Prof. Fleure for no less than three years, during which I was able to prepare the above mentioned thesis. But I have remained in constant touch with Prof. Fleure for the last ten years or more; and during that interval he has taught me much that I shall always value and endear. He has invariably been generous with his time and thought in supervising my work and orientating my lines of research, and he has even found time to read through (and correct the English of) the MS. of the original thesis. His previous studies have been a source of inspiration to me, while the many illuminating discussions I have had with him have supplied me with fresh material for thought. At the same time, however, his generosity of spirit and his broad mindedness have constantly encouraged healthy divergence of opinion between master and student. Indeed, the present work owes him a great deal of its final form, not only for the advice he was always willing to give, but also for the distinctly valuable criticism he often made of my ideas before and after they were written down. With M. l'abbé H. Breuil I have had the advantage of working at the Institut de Paléontologie humaine during various intervals in 1933 and 1934. It was he that initiated me in the technological study of stone industries—a study in which he is a leading authority. He has spent many valuable hours, showing me his vast collections of tools and artifacts from various parts of the world and explaining to me technological details which they exhibit. The particularly instructive discussions I have had with him in the laboratories of the Institut de Paléontologie humaine or in field excursions (in N. France) have

provided me with technical knowledge and training, without which the present work would not have taken its present form. As for Prof. Menghin I have greatly benefited by spending a short, but particularly useful, term at his Urgeschichtliches Institut, in Vienna, during which I followed some of his courses and joined him in some field excursions. He took encouraging interest in my work, and he kindly put at my disposal his vast collections and his rich library. His previous ideas and the many talks and discussions I have had with him were of distinct help in clearing before me several of the dim paths of prehistory.

My thanks are also due to Prof. R. Vaufrey (Paris), Dr P. Woldstedt (Berlin), Dr (the late) W. B. Wright (Manchester), as well as to Prof. G. Wiet (Cairo) and several others whom I cannot all name here. Prof. Vaufrey has kindly shown me his collections and material which he excavated in N. W. Africa. Dr Woldstedt and Dr (the late) Wright have given valuable advice on matters concerning glacial geology, and I have much benefited by goining with them is some field excursions. Prof. Wiet has shown me great encouragement and help while the publication of this book was being considered by the publication committee of the Institut d'Égypte.

Last but not least, I should like to thank my wife, whose inspiring help has never failed me in my work. She has helped in the collection of material relating to the protohistoric and early historic phases of Egypt—her own line of study. She has also read the proofs for me and helped with the preparation of some of the plates and of the general index at end. May she find in the following pages an expression of my affection and gratitude.

PART I.

PAST CLIMATES OF THE OLD WORLD.

(QUATERNARY AND RECENT.)

PART I.

THE CLIMATIC AND BIO-GEOGRAPHICAL SETTING OF THE STAGE.

A DISCUSSION OF THE QUATERNARY AND RECENT CLIMATES OF THE OLD WORLD IN THEIR RELATION TO FORMATIONS, FAUNA AND FLORA.

INTRODUCTORY.

On the Geological Climates of the Saharo-Arabian Belt.

The study of prehistoric societies and cultures over a region like the Saharo-Arabian area can best be approached through a geographical treatment which brings in climatic changes (in the past) and their relation to plant, animal and human life. Such a study would aim at treating the culture-complexes of the past in their proper geographical setting. In trying to reconstruct the geographical stage of human activities of past times, however, we are usually forced to employ bio-geographical observations for inferring changes of climate. But unfortunately data relating to past climates, and drawn from various sources, are not always compatible with each other; and the methods of their interpretation by experts are again less coherent. There is also the constant danger of generalizations and of drawing the same

conclusions from sets of data which may be similar only in appearance. We know for example that prior to Devonian times, the absence of a turf-like vegetation over the earth must have had a marked bearing on æolian erosion and on the formation of tracts of sand and loose earth, which may be taken at first instance as indicating arid conditions [1]. Until, therefore, the time when the evolution of the plant covering in our area (Sahara) had reached an advanced stage, it would be unsafe to speak of old sandstones and similar formations as having necessarily corresponded to desert conditions (in the climatic sense) [2]. Other formations which might have a more illuminating relation to climate (such as salts, gypsum, etc.) are, on the other hand, more easily eroded or obliterated; so that they could hardly afford an unbroken record. In fact, it is not actually possible to trace climatic changes in this region, with any reasonable measure of certainty, before the Carboniferous. At that time the northern part of the Saharo-Arabian Belt was almost wholly under sea. In Upper Carboniferous the land to the north of the Tethys Sea was covered with thick forest, while the southern part of the African continent was under heavy glaciation. The latitudes in between (bordering the Tethys to the south) were, on the other hand, arid or semi-arid [3]. During Permian times little change took place in the distribution of land and sea, and climatic conditions may be supposed to have continued the same [4]. But even when during the Mesozoic, and especially in Cretaceous, the Tethys Sea had covered a large part of the N. Libyan Desert little change took place in the climate. Practically throughout the Mesozoic,

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[1] See J. W. Gregory (1930 *a*), p. 187, where reflections are also made on the value of plant evidence, in general, as an indicator of past climates.

[2] See C. E. P. Brooks (1926), p. 199.

[3] This is, in the view of W. Köppen and A. Wegener (1924), indicated by the formation of salt and of sandstone (*Wüstensandstein*) along the belt of the present Sahara. See *ibid.*, p. 42 and map Fig. 3 on p. 22. Also M. Blanckenhorn (1921), pp. 39-41, for formations of sandstone in Sinai. See also C. E. P. Brooks (1932), p. 60. We may note that whatever may have been the climatic conditions under which the Nubian sandstone may have been formed, it seems that its formation took place during various intervals in the late Palaeozoic and the Mesozoic. Consult good summary by R. Fourtau (1902), pp. 803-804.

[4] C. E. P. Brooks (1932), p. 61.

sandstones, salts and gypsum continued to characterize the formations in N. E. Africa [1]. With the advent of the Tertiary desert conditions became slightly modified. Although gypsum continued to form, the Eocene flora of Egypt became richer and more varied; a sign of increased temperature and rainfall [2]. The favourable conditions became more marked in Oligocene, when no gypsum was formed and the flora became sub-equatorial in character [3]. The fauna is also known to indicate abundant rainfall [4]. Towards the close of the Lower Tertiary, the climate was evidently one of tropical-monsoonal character [5]. But these conditions did not last long as in Upper Tertiary times the old Mediterranean was rapidly receding northwards and aridity began to re-establish itself [6]. In Miocene and perhaps also Early Pliocene, gypsum, salt and relatively poor vegetational life all indicate the

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[1] See C. E. P. Brooks (1932), p. 61; and W, Köppen and A. Wegener (1924), maps Figs. 9 on p. 57 (for trias), 10 on p. 67 (for Jurassic), and 12 on p. 79 (for cretaceous), also pp. 61, 71 and 84.

[2] See M. Blanckenhorn (1921), pp. 76-77, and W. Köppen and A. Wegener maps Figs. 14 on p. 97 and p. 103 for gypsum formations in southern Egypt and northern Sudan in Early Eocene. Also C. E. P. Brooks (1932), p. 61. On Eocene flora see Köppen and Wegener, *ibid.*, p. 109.

[3] See M. Blanckenhorn (1921), p. 110 and W. Köppen and A. Wegener (1924), p. 100.

[4] For comparison of Eocene with Oligocene fauna see M. Blanckenhorn (1921), p. 75 and also pp. 108-112.

[5] C. E. P. Brooks (1932), p. 61.

[6] On the advent of arid conditions in Upper Tertiary, as distinct from Lower Tertiary times, with the end of Oligocene as the division, see W. Köppen and A. Wegener (1924), p. 100 and C. E. P. Brooks (1932), pp. 61-62. On the other hand, M. Blanckenhorn (1921, pp. 118 and 133) finds no reason for such a distinction, as he thinks the climate to have continued to be favourable throughout Eocene, Oligocene and Miocene. This, however, could not mean that during Miocene, and perhaps also the early and middle Pliocene, conditions were not relatively less favourable than before or after. The formations of gypsum in Miocene may testify to this. (For these formations see M. Blanckenhorn, *ibid.*, pp. 119-121 and 124-125.) It may be also useful to recall here, incidentally, the more general character of the change which took place between Lower and Upper Tertiary in many parts of the world. In Oligocene the oceanic transgression seems to have reached its maximum, and such writers as J. Joly (1925), pp. 138-140, would take that as a turning point in the system of radio-active storage and mountain building, which might ultimately have some effect upon the climatic cycles. Palaeontological evidence also points towards the possibility of the division of the Tertiary into two main phases. See J. Walther (1908), p. 483.

re-appearance of somewhat arid conditions over N. E. Africa and N. Nubia [1]. But this finally ended in the renewal of better conditions in Middle and Late Pliocene and Early Quaternary times, a change with which we shall deal in some detail later on.

It would perhaps be well, for the moment, to compare the recent geological past of the Egyptian desert with that of N. W. Africa. The analogy is not absolute, but the shortage of data from the latter region may partly account for the discrepancy. Little is known of the Mesozoic climates of N. W. Africa, but the existence of salt, gypsum and sand-formations may rather tell of dry conditions [2]. This agrees with Egypt. In Lower Tertiary it is not clear whether any change took place. From evidence of terrestrial and aquatic mollusca, Pallary asserts that the Oligocene was rather warm and did not differ much from the present day [3]. This, however, could not be definitely proved through the evidence drawn from land formations [4]. In the Upper Tertiary climatic oscillations appear to have been more pronounced than in Egypt. The Lower part of the Miocene was somewhat temperate, while its Middle and Upper parts were marked with high temperature and abundant rainfall [5]. This soon gave way to aridity and intense evaporation in the Pliocene [6], before the final amelioration of conditions in the Diluvium.

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[1] M. Blanckenhorn (1921), pp. 119-121 and 124-125 as in above note. Also W. Köppen and A. Wegener (1924), map Fig. 15 (on p. 116) and pp. 131-132 (for salt and gypsum formations) and 137 (for vegetation in Mid-Miocene), and C. E. P. Brooks (1932), p. 62.

[2] E. F. Gautier (1922), pp. 61-62 and W. Köppen and A. Wegener (1924), pp. 70-71. For dry conditions in Triassic and Cretaceous see also E. F. Gautier (1923), pp. 46-47.

[3] P. Pallary (1901), p. 201. Apparently this could not be easily reconciled with the fact that there was a transgression of the Oligocene Tethys over a large part of northern Algeria. It should be noted, however, that evidences of mollusca, especially terrestrial ones, may not be always of much value so far as the climatic changes are concerned. The same species may descend almost unaltered through several geological periods with comparatively different conditions.

[4] There are certain gypseous and detrital formations indicating aridity and which are attributed by one school to the Oligocene (see J. Savorin, 1908, pp. 1431-1433) and by another to the Tortonian or Pontian (see L. Joleaud, 1912, p. 245). See also on same controversy E. F. Gautier (1922), pp. 63-64.

[5] P. Pallary (1901), p. 202.

[6] E. F. Gautier (1922), p. 64. A. S. Romer (1928, p. 124) thinks that in Early Pliocene the whole of N. Africa had warm and rather wet conditions.

It seems that the difference between the E. and the W. parts of the Saharan Belt in Tertiary times may be partly accounted for by difference in their respective positions in relation to the Oceans and the Seas [1].

The comparison between the African and the European shores of the Tethys in the Tertiary (see Table I) may be illuminating. On the main block of the European continent the Lower Tertiary was begun with a short spell of cold conditions, followed by a long period of warm climate with dry summers and wet springs [2]. On the other hand in the Archipelago occupying what is now S. E. Europe, the Early Eocene was rather moist with rain all over the year [3]. The Middle and the Upper Eocene were characterized by semi-aridity, while the Oligocene had well marked seasons of rain and drought in the same region. Again unlike conditions in N. Africa the Early Pliocene was marked by the re-advent of moist (warm) climate to the north of Tethys.

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[1] We know, for example, that in Lower Tertiary the Tethys Sea covered a large part of S. E. Europe and W. Asia. While this must have led to an increase in the precipitation over N. E. Africa, it could have hardly had any appreciable effect upon the N. W. part of the continent. In Upper Tertiary the Central Tethys began to be lifted up and this was followed by relative desiccation of N. E. Africa.

[2] C. E. P. Brooks (1926), p. 224.

[3] For the Tertiary climates of S. E. Europe see C. E. P. Brooks (1926), pp. 199-200.

TABLE I.

Tentative correlation of climatic changes, on both sides of the Tethys Sea, since Carboniferous times. Based largely on works by M. Blanckenhorn (1921), W. Köppen and A. Wegener (1924), C. E. P. Brooks (1926) and (1932), E. F. Gautier (1922) and (1923), P. Pallary (1901), J. Walther (1908), J. Savorin (1909), L. Joleaud (1912) and A. S. Romer (1928).

PERIOD.		S. OF TETHYS.		N. OF TETHYS.	
		N. E. AFRICA.	N. W. AFRICA.	N. W. EUROPE.	S. E. EUROPE.
Pliocene	Late	Advent of Diluvium	Advent of Diluvium	Advent of Diluvium	Advent of Diluvium
	Middle	Gradual increase in precipitation (?)	Gradual decrease in temperature and increase in precipitation	Gradual cooling	
	Early	Moderate rainfall (?)	Rather warm with moderate rainfall. Similar to present. Chotts... etc. Also gypsum.	Rather warm	Rather warm and moist
Miocene	Late	Relatively dry climate with relatively poor veg.	Warm and humid	(?)	(?)
	Middle				
	Early	Formation of salt and gypsum	Temperate (similar to present?)		
Oligocene		Rich and varied flora. No dry-climate-formations	As present (?)	Long period of warmth with dry summers and wet springs. Rain of instable character	Well marked dry and wet seasons
Eocene	Late	Somewhat enriched flora	Less arid		(?)
	Middle				Semi arid
	Early	Gypsum		Slight cold spell	Rather moist. Rain all seasons
Cretaceous		Salt in Up. Nubian Sandstone. Arid	Steppe. (Red Sandstone)	(?)	
Jurassic		Nubian Sandstone. Rather arid (with no fossils)	Salt and gypsum. Dry (or rather so)	(?)	
Triassic				Salt deposits (dry)	
Permian		Nubian Sandstone (Dry?)			
Carboniferous		Dry (desert?)	Dry	Warm, wet, forests.	

Explanations of Pre-Quaternary Oscillations of Climate in Saharo-Arabian Area.

Two chief explanations of climate oscillations over the W. and N. W. parts of the Old World during Secondary and Tertiary times have been put forward. Köppen and Wegener believe that there was, at first, a general (though gradual) shift of the continent of Africa across the Equator from S. to N., and then a slight recession in the opposite direction. According to their scheme, the Saharan Belt first passed through the S. arid zone in late Primary times, then across the Equator about Oligocene times, after which it entered the N. arid zone from Upper Tertiary times onwards. In Pleistocene it receded slightly southwards but remained in the same zone [1]. We are not at present prepared to discuss this hypothesis, as it raises points of difficulty with which only geologists and geophysicists could deal. Suffice it to point out that it may lead into a viscious circle in which the shift of the continent is demonstrated by the climatic record, and the latter is, in its turn, explained by the suggested shift. C. E. P. Brooks, on the other hand, lays more stress on the effect of the Tethys Sea on the climate of the surrounding lands [2]. There can be little doubt that there is a certain measure of truth in this suggestion. The effect of the Tethys was especially marked during such times as the Lower Tertiary when Tethys reached its maximum extension and had warmer waters (than it had e. g. at the close of Tertiary), as indicated by its malacological fauna [3]. This, however, could not have always been the case, as, although the Tethys is known to have transgressed southwards during the Cretaceous, salt was being formed in the northern stretches of the Nubian Sandstone area—an indication of relative aridity (*vide supra*). We, therefore, prefer to think that these changes in the dimensions of the Tethys could not always have been the only factor in determining the climate of the Saharan

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[1] See the suggested co-ordinates for the Poles and for the Saharan Belt and other parts of Africa in W. Köppen and A. Wegener (1924), pp. 154-157. Also diagram drawn from the documents of these authors in C. E. P. Brooks (1932), Fig. 17 on p. 63.

[2] C. E. P. Brooks (1932), p. 61.

[3] On the Tethys during this period see W. Köppen and A. Wegener (1924), pp. 112-113. Also reference, though not very clear, to the difference between the fauna of the S. coasts of Europe in L. and Up. Tertiary is given in J. Walther (1908), p. 483.

Belt. The distribution of the other land and sea tracts in relation to the N. African block must have played an important part. There is little reason to think that the general system of climatic zones over the globe has undergone any radical change within geological times[1]. The amount of precipitation over the N. (or Saharan) arid Belt of the globe (or at least the southern edge of that Belt) must have always been affected by the S. E. trade winds (after having crossed the Equator). Whether these latter passed over seas or land in what is now the western basin of the Indian Ocean was a matter of first class importance for the rainfall of Erythrea and Nubia. From Mid-Mesozoic times onwards the Gonduanaland Continent began gradually to break up, but it was not until the first part of the Tertiary that its remnants (like Lemuria) were appreciably reduced in size[2]. This might have had something to do with the more favourable climate of the eastean part of the Sahara in Early and Middle Tertiary as compared with Secondary times. In Late Tertiary, on the other hand, the Arabian and Persian land-masses were finally taking shape and the access of the monsoons of the Arabian Sea towards Erythrea and Nubia was much checked.

We see from Table I that towards the end of the Tertiary there was an on-coming of cold conditions—*refroidissement*—over the areas hitherto discussed. We shall see, as we proceed, that this phenomenon was in all probability a world-wide one[3]. It heralded the so-called Great Ice Age over the whole world. The record left by the climatic oscillations during Later Tertiary and Quaternary times is naturally better preserved and could be studied with more certainty than that of former climatic changes. It is interesting to note that not only does this series of oscillations appear to have started simultaneously in different parts of the world, but it also seems

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[1] See reference in J. W. Gregory (1930*a*), p. 187.

[2] Compare maps Figs. 29, 34 and 40 in J. W. Gregory and B. H. Barrett (1931).

[3] For reference to this *refroidissement* (at the end of the Pliocene) in general see Ed. Brückner (1890), pp. 4-5 where he refers to the phenomenon as taking place *in Tertiar;* for Europe see W. B. Wright (1937), pp. 103-105, and E. Antevs (1934), p. 150; for the Mediterranean see F. W. Harmer (1926), pp. 32-33 (where a discussion is made of the temperature of Mediterranean waters); for C. and E. Africa see A. T. Hopwood (1930), p. 303; for Australia see E. Antevs (1928), p. 44; etc.

to have come to an end about the same time. The geo-chronological work of De Geer and his students on the seasonally varved clays in Scandinavia and in North America has shown that the final waning of the last covering of ice over the northernmost stretches of the two continents was a parallel event[1]. According to calculations, it took place about 14.000 years ago, but this was probably preceded by a similar period of preparative recession[2]. The Post-Glacial period in the Alps, according to Penck and Brückner, began 20.000 years ago, in round figures[3]. It is, therefore, clear that the synchronism of the final recession of the ice is only approximate and that the geo-chronological reckoning could not be absolutely true in all its details[4]. But it is interesting to note that the state of weathering and valley sculpture in the drift deposits over Europe and N. America shows a remarkable degree of correspondence between the earlier Pleistocene stages of glaciation over the two continents[5]. In fact the synchronism of the Late Tertiary and Quaternary glaciations, not only over Europe and N. America, but also over the other glaciated parts of the world, is now accepted by nearly all students of this delicate question[6]. The lowering of the snow-line in Pleistocene (glacial stages) by the same extent (usually *c.* 1.200 m.) in the N.

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[1] G. De Geer (1910), pp. 303-310, E. Antevs (1922), p. 3 and (1925), pp. 9 and 54 and (1928), pp. 4 and 151-168. The same method has been recently applied to the extreme south of S. America, where the oscillations during the final retreat of the ice are stated to be (on evidence of stratigraphy) parallel to those of northern Europe and N. America. See C. C. Caldenius (1932), pp. 153-157. It should be noted, however, that this so-called method of tele-connection is still open to criticism on geological, stratigraphical and mathematical grounds. See C. E. P. Brooks (1928), pp. 65-67.

[2] E. Antevs (1925), p. 54 and (1928), p. 155.

[3] A. Penck and Ed. Brückner (1909), p. 1169.

[4] As we shall see later on, the summer temperature has a great deal to do with the development or the melting of ice. It is quite often that a cool summer in N. America corresponds to a warm one in Europe and *vice-versa*. This is thought by W. Köppen and A. Wegener (1924, p. 237), to throw doubt on the tele-connections of De Geer and his students. See also P. Woldstedt (1929), p. 290.

[5] See works of Fr. Leverett (1910), pp. 241-295 and 331-342; also H. F. Osborn and C. A. Reeds (1922), p. 478; E. Antevs (1925), p. 55 and (1928), p. 4, and C. E. P. Brooks (1922), p. 48.

[6] Amongst the dissenters from this view, however, we may note J. W. Gregory (1930*a*), p. 189.

and S. Hemispheres as well as on the Equator points strongly to the possibility that it was caused by a world-wide and more or less standardized change in climatic conditions [1]. This is supported by the fact that the series of climatic oscillations on the Equator (so far as could be assessed) is, on the whole, in agreement with those of the N. and the S. Hemispheres [2]. In fact, whatever may have been the case with climatic changes in earlier geological times, it is practically certain, in the light of recent studies, that the ones that marked the most recent chapter of the geological history of the Earth were of more than local significance.

Necessity of Study of Climatic Episodes in other Latitudes for Proper Understanding of those of Saharo-Arabian Belt.

The place of the Saharo-Arabian Belt in the climatic system of Late Tertiary and Quaternary times is of special significance. We have just seen that the climatic conditions prevailing over this region in earlier geological times were largely governed by the land and sea distribution to the N., N. E. and S. E. of it. Such an explanation, however, could not be applied to the oscillations in the climate during more recent geological times. Since the close of the Tertiary land and sea changes in this region have not been sufficient to affect seriously the climatic régime. Factors affecting this climate are to be looked for over a much wider area. In fact, a good understanding of the story of recent climatic changes over our area could be reached only through the study of similar changes over other climatic belts to the N. and the S. of it. For reasons which will crop out later on in the discussion, it

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[1] See works of A. Penck (1914), pp. 281-293, especially p. 285. Also on same point E. Antevs (1928), pp. 70-93, P. Woldstedt (1929), pp. 334-337 and E. Nilsson (1931), p. 333.

[2] See F. Jaeger (1926), pp. 1 and 61. If the climatic changes in the two Hemispheres were alternate, then we should have expected to have a more eventful series of changes on the Equatorial Belt than in either of the two Hemisphered. This is far from being the case. It seems to be out of the question that the changes along the Equator should have been synchronous with those of one Hemisphere and not the other. Some authors, however, although maintaining the idea of synchronism, tend to think that the first phase of glaciation at the end of Tertiary started a little earlier in Antartica than in the N. Hemisphere. See C. E. P. Brooks (1926), p. 89.

is necessary that the survey of the N. latitudes should be attempted first. In our treatment, we propose to proceed "backwards", *i. e.*, starting from proto-historic times and finishing in Late Pliocene. This method of procedure may prove a little hazardeous, but, with a fair amount of care, it should provide us with a more secure "starting point" than the other end of the story;—the close of Pliocene and the beginning of Pleistocene being still a matter of controversy amongst geologists [1]. The basis of the treatment will inevitably be geological, palaeontological and stratigraphical especially as one proceeds further back. Archæological evidences will come in only when their help for correlation purposes is both necessary and safe [2].

GLACIAL EPISODES IN N. W. EUROPE.

British Isles.

We shall begin our zonal survey of past climates with the northwesternmost part of the European continent. This region (especially its western part) was one of the main centres of glaciation in Quaternary times, and it seems to have exerted a marked influence, both directly and indirectly, upon the climates of lower latitudes. The data we have from it come either from the British Isles, from Scandinavia and N. Germany or from the plains further East. The close of the glacial period in this region was marked by a period

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[1] Although, from the point of view of geological times, the difference between the beginning of proto-historic times in different countries is negligible, we shall see at the conclusion of the present Part of our work that the "divide" between Pliocene and Pleistocene may not have been the same in different parts of the world. The risk in adopting such a "divide" as a starting point in comparative chronology becomes therefore all the more obvious.

[2] The controversy between archæologists on the dating of various cultures will be treated in Part II. For general statements and references on this controversy see O. Menghin (1931), pp. 21 et seq. We may take it, however, that on the wohle, there is agreement (or semi-agreement) between the two schools of long and short chronology amongst prehistorians on such points as the placing of late Acheulean and Early Mousterian cultures in W. Europe (and presumably also in N. Africa) towards the end of the Riss-Würm Interval. There seems also to be agreement on placing the early Up. Palaeol. in W. Europe between Würm and Bühl. Only such points as these will be used freely in the present discussion, while others (such as the place of the beginning of the Chellean or Acheulean) will be only carefully alluded to.

of rising temperature during the so-called "Climatic Optimum". In the British Isles the traces of this period have never been fully worked out. From the evidence of raised beaches in N. E. Ireland, however, the existence of such a recent warm phase is established beyond doubt. Working on shells from a littoral formation at Larne, Belfast (Alexandra Dock), and elsewhere in Northern Ireland, R. Ll. Praeger has shown, as early as 1892, that during a phase of land-depression a warm fauna (known, as the *Thracia* zone in the littoral section) has spread northwards. The coasts of N. E. Ireland had the present water temperature of Bantry Bay—an increase of 3° - 4° F. in the mean annual temperature [1]. This warm phase of high sea waters is regarded by W. B. Wright as belonging to the Early Neolithic Beach formations [2]. It was preceded and followed by somewhat lowers waters with a temperature not very different from that of the present day. Evidences relating to the very close of the Ice Age, however, are still lacking from the Brit. Isles. All that we know is that there was probably a re-advance in the Scottish Ice during its final waning [3]. Prior to that we have distinct data of four glacial stages separated by three intervals. These are summarized briefly in Table II which covers only S. E. England and the Upper Thames, where the evidence is best known.

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[1] See work of R. Ll. Praeger (1892), pp. 212-289; also C. E. P. Brooks (1922), p. 130-131 and W. B. Wright (1928), p. 101.

[2] W. B. Wright (1928), pp. 100-101.

[3] See P. G. H. Boswell (1932), p. 77 and Table facing, p. 88.

TABLE II.

Summarized Table of Upper Pliocene and Pleistocene changes of climate in England. Based very largely on P. G. H. Boswell (1932) with slight modifications and additions according to K. S. Sandford (1933 *c*) [see also K. S. Sandford (1929 *a*)], J. D. Solomon (1932), S. H. Warren (1923), M. C. Burkitt (1932 *a*) and W. B. Wright (1937). Table reads upwards and no time-scale is attempted.

PERIODS.	SUFFOLK AND NORFOLK.	L. THAMES AND S. E. COAST.	UP. THAMES.
IVth Glacial	Hunstanton Brown Boulder Clay (with Mid. Aurignacian implements)	Lea Valley, Ponders Edge stage	Deep channel filled at base, cold. Flood-plain gravels
3rd Interglacial (Interstadial?)	Hill washes. Aurignacian to Solutrean Morston raised beach Hill washes, river-silts and brickearth. Up. Mousterian	Erosion and deposition of Coombe rock. Moust. to Up. Mousterian	Excavation of deep channel Erosion, warp and hill-washes
IIIrd Glacial	Upper Chalky Drift. (Levallois implements?)	Coombe rock. Mousterian = 50 ft. terrace (?)	Warp, frozen soil, top of Wolvercote terrace
2nd Interglacial	Brickearth (Early Mousterian), temperate Gravels. (Up. Acheulean) Brickearth, peat, cold Brickearth, temperate	Period of Erosion (?) 100 ft. terrace (with *Corbicula fluminalis*)	River clays and peat (with Mousterian), cold to temperate Lower gravels of Wolvercote channel. Up. Acheul. Up. Summertown-Radley terrace, warm. *Corb. fluminalis* L. Summertown-Radley ter., cold
IInd Glacial	Chalky Jurassic Boulder Clay Contorted Drift	Chalky Jurassic Boulder Clay	Wolvercote terrace
1st Interglacial	Glacial sands and gravels	*El. antiquus* Bed of Clacton (= W. Wittering and Selsey formations)	100-140 ft. terrace
1st Glacial	Norwich Brickearth. Cromer Till?		Plateau gravels
Pre-Glacial	Forest Bed (warm) The Crags (*refroidissement*)		

The fourth (Hessle) glaciation was not at all extensive in Norfolk as is shown by the thinning off of its Brown Boulder Clay at the N. W. border of the province [1]. The interglacial phase which preceded it was also not well marked and could by no means compare with the two preceding interglacials. It may even be better regarded as an Interstadial separating two stages of one and the same glacial phase [2]. The preceding glaciation (so-called Little Eastern) was responsible for the Upper Chalky Drift and probably also for Coombe Rock formations in the L. Thames. It was preceded by a better marked and more interesting interglacial than the one just discussed. From evidence from East Anglia, however, this 2nd Interglacial was characterized first by temperate, then cold and then again temperate conditions [3]. *Corbicula fluminalis* appears towards its beginning [4]; but it is again followed by a short sejourn in E. England of Northern plants and animals. To this short spell is attributed the presence of facetted pebbles in some of the gravels, pointing to vigorous wind action, possibly connected with anticyclonic conditions in N. W. Europe [5]. Towards the close of the Interval, conditions ameliorated again; but it seems that the N. of England was still under severe conditions. The Second Glacial (so-called Great Eastern) marks another important event in the story of Quaternary climates here. It was the first purely *home-developed* ice-sheet in Britain. It seems also that during this phase the extension of the ice reached its maximum over the greater part of

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[1] P. G. H. Boswell (1932), pp. 74 and 88.

[2] During this interval, Upper Palæolithic man was able to establish himself on many sites and to reach caves in Derbyshire and N. Wales; but his existence there does not necessarily imply that the extreme north of England was entirely free from ice. At any rate the formations of this interval are not stratigraphically clear as yet, and it is probable that it represented little more than a short recession of the ici-front.

[3] Although K. S. Sandford (1933 *c*, p. 864) regards this as the "most marked" Interglacial, there seems little doubt that it was much shorter than the Ist Interglacial, and that it was also interrupted by a cool phase (or sub-phase). See P. G. H. Boswell (1932), p. 87.

[4] Though the value of this fresh water mollusc as an indicative of temperate conditions is now very much in doubt. See review on "World Climate during the Quaternary Period" in *Nature*, No. 3369, vol. 133, May 26th 1934, p. 786.

[5] See P. G. H. Boswell (1932), p. 87.

the country [1]. To this glaciation is to be attributed the important formation of the Chalky Jurassic Boulder Clay. The Interglacial which preceded it was again of special importance. In matter of time it was certainly much longer than any of the ones that followed it. It was at least partly marked by a gradual rising of the land, followed by strong erosion. The Brickearth glacial deposits which immediately preceded it were greatly weathered and valleys cut extensively into them. Although apparently its early part may have been broken through by slight oscillations (during the gradual retreat of the ice) [2], there seems to be little doubt that its climate remained on the whole genial [3]. To this period is also attributed the warm *Elephas antiquus* Bed of Clacton-on-Sea whose flora and non-marine mollusca indicate slightly drier and warmer conditions than to-day [4]. This interval was preceded by the Ist (North Sea) Glacial represented by the Norwich Brickearth (and probably also the Cromer Till?). The on-coming of cold conditions was also accompanied by cold sea waters as indicated by the *Leda myalis* Bed [5]. As the ice advanced erratics were brought from Norway to the East coast of England; thus indicating a very strong phase of glaciation in the former country [6]. This period, however, was not so well marked (as the 2nd Glacial) in the Upper Thames, where its traces are preserved in the form of Plateau Drifts and Gravels [7].

The so-called Pre-Glacial period of England is not less interesting. Below

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[1] This is true at least of C. and E. England. See K. S. Sandford (1933 *c*), p. 863; also P. G. H. Boswell (1932), pp. 86-87.

[2] Sands characteristic of glacial or semi-glacial conditions appear in the first part of this Interglacial. See P. G. H. Boswell (1932), pp. 67 and 86.

[3] K. S. Sandford (1929 *c*), pp. 375 and 383.

[4] E. M. Reid and M. E. J. Chandler (1923), pp. 620-621 and A. S. Kennard and B. B. Woodward (1923), pp. 633-634; also H. Breuil (1932), pp. 133-134. This bed is regarded as the equivalent of the temperate deposits of W. Wittering and Selsey in Sussex. On these see C. Reid (1892), pp. 357-359.

[5] P. G. H. Boswell (1932), p. 66. The *Leda myalis* Bed, however, seems also to include *Ostrea edulis*, which requires a temperate sea. So the evidence is rather conflicting. See W. B. Wright (1937), p. 111.

[6] P. G. H. Boswell (1932), p. 66; also J. Geikie (1914), pp. 251-253.

[7] K. S. Sandford (1929 *c*), p. 383.

the Ist Glacial series we have the Cromer Forest Bed. This is characterized by its well known warm fauna including *Elephas meridionalis, Elephas antiquus, Hipp. amphibius, Rhinoceros etruscus* (Falc.), *Equus stenonis* (Cocchi), *Equus caballus* (Lim.), *Cervus Elaphus* (Linn), etc.[1]. The flora of this Bed is rather illuminative as it has an association indicating that climate and geographical conditions, as a whole, were very similar to those of Norfolk at the present day[2]. But prior to the laying down of this Bed there was a gradual period of cold conditions (*refroidissement*) taking us right through what is usually regarded as the Upper Pliocene. The uppermost series of the Crags representing this phase of refrigeration (the Weybourn Crag) has 33 % of its mollusca of northern types. As we go further back this percentage decreases until it is only 1 % in the Coralline Crag which, on the other hand, has 26 % of its species belonging to southern types[3].

The evidences from the raised beaches in Britain are not easily worked out, and are in fact of little help in tracing past climates. There appear to have been too many differential movements of the coast-land from Up. Pliocene onwards to make any correlation of the various beaches practicable[4]. The Scottish beaches indicate cold conditions but they appear to have been largely formed during periods of glaciation when the weight of the ice depressed the land[5]. At two points in the S. of England (Portsmouth, 100 ft. and Barnstable, 50 ft.), there are evidences of warmer waters, indicating that these beaches were formed during one or perhaps two Interglacials; but again here it is difficult to give any dating to the sites[6]. Other beaches are of a "banal" character and need not be mentioned here.

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[1] W. B. Wright (1914), pp. 88-89 and (1937), pp. 106-110; also J. Geikie (1914), p. 250.

[2] W. B. Wright (1914), p. 90 and (1937), p. 110.

[3] See W. B. Wright (1914), p. 85 and (1937), p. 105; also M. C. Burkitt (1932*a*), p. 1 and (1933), pp. 82-83. The lower part of the Pliocene was, on the other hand, a period of warmth and of very equable conditions. See J. Geikie (1914), pp. 246-247.

[4] J. W. Gregory (1930), pp. 83-88.

[5] On Scottish beaches see W. B. Wright (1914), pp. 369-373 (1928), pp. 102-104 and (1937), pp. 367-387.

[6] On Portsmouth see J. W. Gregory (1930), p. 87. (It is not clear, however, whether by the "warm fauna" of this beach, the author means marine species). On Barnstable see D. Baden-Powell (1828), pp. 109 and 111 and (1927), p. 435.

Scandinavia and the N. Plain.

We must now turn to other parts of N. W. Europe. The story of the Ice Age has been better worked out over the mainland than in Britain[1]. Starting from proto-historic times we find that there was a period of marked increase in temperature especially in summer[2]. It is true that towards the end of the Bronze Age (or roughly from 850 B. C. onwards) there was a short cold and wet phase known as the Sub-Atlantic; but prior to that there were three phases of warm dry (Sub-Boreal, 2500-850 B. C.), warm and wet (Atlantic, 5500-2500 B. C.) and temperate (leading to warm) dry (Boreal 6500-5500 B. C.) climate[3]. The last and the first of these phases had a continental character, while the middle one (Atlantic) was oceanic. During it the warmth-loving plants which had begun to immigrate during the latter part of the Boreal phase continued to spread northwards and became more and more associated with species requiring a higher rainfall[4]. It is probable that the highest average temperatures and rainfall were reached at a time

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[1] This may have been partly due to the fact that from the very outset the poly-glacial School gained support on the Continent; and so workers have set on the collection of data relating to the various stages of Glacials and Interglacials.

[2] For Post- and Late-Glacial changes in general see P. Woldstedt (1929), pp. 208-227, and various articles in the work edited by G. Andersson (1910). Also G. Erdtman (1934), pp. 105-107 and W. B. Wright (1937), pp. 333-366. For C. Europe (also bearing on the N. W.) see work of H. Gams and R. Nordhagen (1923).

[3] See C. E. P. Brooks (1928*a*), pp. 309-312 and (1931), pp. 269. This author (1928*a*, p. 309) regards the Boreal phase (the oldest) as cool. This seems to apply only to its early part as it became warm and dry during its latter part (the inland sea of Ancylus II). See W. B. Wright (1914), pp. 333-334 (based on G. Andersson 1910*c*, pp. 247 et seq); also P. Woldstedt (1929), pp. 220-221, W. A. Johnston (1933), p. 38 and W. B. Wright (1937), pp. 343 and 347. It is interesting to note that the rise of temperature took place in spite of the fact that the land had slightly risen in relation to the sea. The warmth was naturally further increased in the following phase (Atlantic) when the Baltic was re-connected with the Ocean; but it should be noted that the rise of temperature in late Boreal times was a "real" one, as it took place independently of any Oceanic influence. The term «Climatic Optimum» is usually given to indicate the latter part of the Boreal and the whole of the Atlantic phase; see W. B. Wright (1937), p. 449.

[4] C. E. P. Brooks (1922), pp. 128-129. On the question of the migrations of flora in Post-Glacial times as a whole see G. Andersson (1910*c*), pp. 247-301; H. Peake and H. J. Fleure (1927), pp. 36-38 and W. B. Wright (1914), pp. 427-440.

of maximum submergence (the so-called *Littorina litorea* phase). This is indicated by the increased salinity of the Baltic and the introduction in its waters of warmer marine malacological fauna (warmer than that of the present day)—thus indicating free connection with the Atlantic [1]. The same phase of depression and warmth is also illustrated on the shores of Norway by the *Tapes* beds [2]. *Tapes decussatus* is itself a species from further South, and is here associated with a rich warm fauna, requiring a rise in sea temperature first of 4° F. and later on of 2° F. above the present. Several species, some of which coming from as far South as the English Channel have been found at intervals on the Norway coast, specially the Christiana banks. They even reach as far North as Tromso within the Arctic circle. The Gulf Stream must have been very strong as a West Indian bean, *Entada scandens*, is said to have been found at the base of a peat-bog on the west coast of Sweden [3]. In fact the rise of temperature seems to have been a phenomenon of wide distribution over the whole of the N. of the Atlantic. Recent raised beaches with warm mollusca have been found in Spitzbergen (30-80 ft.), Franz Josef Land (10-20 ft.) and Murman coast (White Sea); and peat bogs were found in the former, where they do not form at the present [4]. There is at present no direct evidence to link up all these recent formations with the *Littorina-Tapes* phase, but their wide distribution and the existence of similar data from W. and E. Greenland, N. Iceland and even as far East as the New Siberian Islands (as we shall see a little later) would argue for their contemporaneity.

The exact story of the retreat of the ice over the Scandinavian Peninsula

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[1] W. B. Wright (1914), pp. 349-354 and (1937), pp. 347-351. Also C. E. P. Brooks (1922), p. 128, and P. Woldstedt (1929), pp. 221-222.

[2] W. B. Wright (1914), p. 440 and (1937), pp. 361-362, C. E. P. Brooks (1922), pp. 129-130, and P. Woldstedt (1929), p. 222.

[3] Specimens of this bean, however, are frequently drifted ashore along the coasts of Ireland, Scotland and Norway, having floated across the Atlantic on the Gulf Stream. W. B. Wright (1914), p. 440.

[4] See work of Ad. S. Jensen and P. Harder (1910), pp. 399-407; also C. E. P. Brooks (1922), p. 130. For plant evidence relating to this warm period in Spitzbergen see also G. Andersson (1910*b*), p. 417.

and the N. German Plain during the so-called Late Glacial period (*Spätglazialzeit* as distinct from *Postglazialzeit*) is much too complicated to be discussed here in detail [1]. We know that this retreat was at first very slow and that it was broken through by several stadia. The last of these is the so-called Ragunda Pause. Prior to this there was the Finiglacial Retreat when the ice was rapidly receding over N. W. Finland and C. Sweden [2]. The Fenno-Scandian Stadium which preceded it was the last-but-one of ice stadia and its moraine lies roughly half-way between the centre and the limits of the Swedish Late-Glacial ice sheet [3]. It was again preceded by a more important phase of recession (the Gotiglacial) [4], separating it from the last stadium of the ice over S. Scandinavia (and perhaps also N. Denmark). But the most important of all recessions took place while Scandinavia still lay buried under ice which extended beyond it. This is the so-called Dani-Glacial Retreat, whose duration has not been determined but whose importance in the Late-Glacial history of the S. Baltic is well recognised. In fact since the last glaciation of N. W. Europe (the Weichsel glaciation proper) reached its maximum (marked by the "Brandenburger Stadium"), there was a semi-continuous recession (broken by such stadia as the "Frankfurter" and "Pommersches") till N. Germany, the S. Baltic and Denmark were finally liberated from ice [5]. Yet the fact that the ice sheet was still considerable through the whole of this phase of recession makes it difficult to regard any portion of it as an Interglacial in the proper sense.

The stages of glaciation proper over this part of Europe are fairly well known and we need only refer to the tabular sumary given below. From Table III we note the existence of three main glaciations (Weichsel, Saale

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[1] See good account in P. Woldstedt (1929), pp. 166-168 for N. Germany and pp. 211-212 for the extreme N. W. of the continent.

[2] This is estimated by G. De Geer to have lasted for about 1000 years only. On estimates for such retreats and stadia see G. De Geer's work (1912*b*); also references in P. Woldstedt (1929), p. 212.

[3] E. Antevs (1928), p. 163 and map of Scandinavian stadia.

[4] The length of the Gotiglacial Retreat is estimated at 3000 years. See P. Woldstedt (1929), p. 212 and C. E. P. Brooks (1931), p. 269.

[5] P. Woldstedt (1929), pp. 166 and 168 and map Abb. 85 on p. 167.

and Elster), the second of which having probably been the most extensive (though only by a small margin)[1]. It was apparently characterized by a great extension of the ice-covering over the N. European Plain especially on its S. E. and S. W. fringes[2]. The Elster glaciation, which preceded it however, does not appear to have been much less extensive. In fact, in S. W. Poland and perhaps also in S. Germany, it reached further south than the Saale[3]. The chief difference between these two great glaciations may have been that, while the former (Elster) was more pronounced in such moutainous areas as Scandinavia[4], the latter was especially developed over the plains[5]. It is quite probable that during the Elster (as during the Saale and the Weichsel) there were formations of loess directly to the south of the edge of the ice-sheet, but that such formations have been "altered" (*verändert*) or entirely removed by subsequent denudation[6]. Prior to it there seems to have been a fairly prolonged phase of unsettled and little-known conditions (usually known as the *Präglacialzeit*) in N. W. Europe.

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[1] The exact status of the so-called Warthe Stadium which took place between Saale and Weichsel is still not clear. It can be considered either as a Stadium which followed the retreat of the Saale, or as an advance phase which preceded the Weichsel. See e. g. reference in F. E. Zeuner (1935), pp. 353 and 357.

[2] In Belgium evidence of flora shows that rigorous conditions were not so pronounced during the period corresponding to the first glaciation (Elster) as they were during that corresponding to the second glaciation. See A. Rutot (1910), pp. 39-40 and 44. On the Russian Table-land Saale reached lat. 50° to the South and its sheet nearly touched that of the Urals to the East. Elster here was much more restricted. See P. Woldstedt (1933), p. 372 and Abb. I on p. 373.

[3] See P. Woldstedt (1929), p. 182 and Abb. 83 on p. 159; and (1933), p. 372 and Abb. I on p. 373. Also W. Szafer (1928), pp. 21-33.

[4] It is practically certain that it was this glaciation that sent its erratics as far as the coast of E. England. *Vide infra.*

[5] As we shall see later on, there are two chief factors in the development of ice-fields, namely the decrease in temperature and the increase of precipitation (in solid form). The former would favour the development of ice in mountain regions (where the snow line is lowered), while the latter helps the accumulation of ice on the plains. The fact that one of these two factors might have been more prominent than the other might throw useful light on the difference between the Elster and the Saale Glacials.

[6] See W. Soergel (1919), p. 173. On the process of loess-formation especially during the advance phase (*Vorstossphase*) and maximum of glaciations see *Idem,* pp. 24-25, 79 et seq., 173-177 and Fig. 8 on p. 96.

It is thought by certain authors that a still older glaciation (the oldest) took place at least in Scandinavia and on the land East of the N. Sea at time which may be roughly regarded as Up. Pliocene[1]. But the existence of this glaciation is still a matter of conjecture, and it may have been only a phase of refrigeration (*"phase glaciale"*)[2].

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[1] See works of E. Stolley (1929) and O. Grupe (1922); also P. Woldstedt (1929), p. 293. This very cold phase was probably followed and separated from the Elster glaciation, by a warm phase with a fauna very similar to that of the Cromer Forest Bed in England. The Telegen Beds in N. Germany have furnished *Elephas antiquus, Hippopotamus major, Rhinoceros etruscus, Equus stenonsis,* etc. They apparently also include the warm mollusc of *Paludina diluviana.* See P. Woldstedt (1929), pp. 193-194. A similar warm phase is suggested for W. Poland and is thought to have been preceded by another glaciation. See W. Szafer (1931), pp. 19-50; also P. Woldstedt (1933), pp. 371-372 and 378.

[2] The useful distinction between the two French expressions of *"phase glaciaire"* and *"phase glaciale"* may be recalled.

TABLE III.

Glaciations and Late- and Post-Glacial phases in N. C. and N. W. Europe. Based chiefly on works mentioned in the footnotes on pp. 19-23. (The Table reads upwards, and no time-scale is attempted in it.)

PHASES.		FORMATIONS AND CLIMATES.	
Post-Glacial	Sub-Atlantic (circ. 850 B. C. onwards)	Cold, wet	
	Sub-Boreal (circ. 2500-850 B. C.)	Warm, dry	
	Atlantic (circ. 5500-2500 B. C.)	Warm, wet. *Littorina* Sea and *Tapes* Beds	
	Boreal (circ. 6500 5500 B. C.)	Ancylus Lake II. Warm, dry Ancylus Lake I. Cool, dry	
Late-Glacial	Ragunda Pause } circ. 8000- Finiglacial Retreat } 6500 B. C.		
	Fenno-Scandian Stad. (circ. 10.000-8000 B. C.)	Fenno-Scandian moraine	
	Gotiglacial Retreat (circ. 13.000-10.000 B. C.)		
	Gotiglacial Stadium	Moraine	
	Daniglacial Retreat with Stadia	Moraines of Frankfurter and Pommersches Stadia. Perhaps slight Loess too.	Last glaciation with Stadia. New Loess and Lower terraces
Glacial	Weichsel glaciation (including Warthe?)	Brandenburger and other moraines	
	Saale-Weichsel Interglacial	Warm (or temperate) Skärumhede Series Cold Warm. Eemian Sea	Formations of Rixdorf and Taubach-Ehringsdorf
	Saale glaciation (with Warthe Stadium?)	Maximum glaciation. Old Loess. Middle terrace of Rhine	
	Elster-Saale Interglacial	Very long and relatively warm. Denudation and redeposition of glacial material. Warm formations of Hundisburg, Krölpa in Thüringen and *Paludina* Bank near Berlin	
	Elster glaciation	Upper terraces of Weser, etc. Another old Loess(?)	
Pre-Glacial	Oldest Interglacial(?)	Warm conditions. Tegelen Beds	
	Oldest glaciation or glacial phase(?)	Cold conditions. Cold (or glacial) formations in Weser Valley and Sweden(?)	

Interglacials of N. Europe.

The Interglacial phases of the Ice Age in N. W. Europe offer another controversial problem. It is almost certain that during both of the recognized Interglacials, there was a considerable amelioration of climate, but the problem is whether this lasted throughout the interval. The last (Saale-Weichsel) Interglacial was less protracted than the previous one. It comprises such formations as Rixdorf and Taubach-Ehringsdorf [1]. The fauna of these formations was of a rather mixed character, comprising *Elephas antiquus, Rhinoceros Merckii, Sus scrofa, Cervus elaphus,* etc., together with *Elephas primigenius* and *Rhinoceros tichorhinus* [2]. The evidence from the flora, however, points definitely to the existence of a sub-arctic phase (with *Betula nana* . . ., etc.) within this Interglacial [3]. This is also supported by the conclusions arrived at by Wiegers from the study of the travertine section of the Ehringsdorf formations which clearly indicates two warm sub-phases with a cool one in-between [4].

The sea formations relating to this interval are not without interest. In N. Jutland the Skärumhede series of "Lusitanian" molluscs is placed in the latter part of this interval [5]. It indicates a relative rise in the temperature

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[1] See P. Woldstedt (1929), pp. 179 and 296-298. Also works of W. Soergel (1926) and Fr. Wiegers (1928*a*). Also references in H. Obermaier (1907*a*), p. 389 and R. Vaufrey (1931) p. 536.

[2] Although the earlier part of this interval was admittedly warm, it is reasonable to argue that the existence of warm fauna at such points as Ehringsdorf was further favoured by local conditions. Also such species as *Rh. Merckii* are known to have had a remarkable power of persistence from warm into colder times. See R. Vaufrey (1928), pp. 72-74 and L. Joleaud (1931), pp. 682-683. Also general warning against the possibility of survival of types of warm fauna and flora during periods of glaciation in particularly favoured spots is given in G. Negri (1933), pp. 739-740.

[3] P. Woldstedt (1929), p. 181.

[4] See work of Fr. Wiegers (1928*a*) and reference in P. Woldstedt (1929), pp. 257-258. There is little reason to accept W. Soergel's view (1926) (also reference to same view in R. Vaufrey, 1931, p. 526) that this cool sub-phase represents a slight oscillation at the beginning of the last glaciation. We shall see, a little later, that this three-fold division of the Saale-Weichsel Interglacial also holds good for E. Europe. It would be useful to keep this in mind as it throws considerable light on the problem of correlations of climatic changes, not only in Europe but also in more southerly latitudes.

[5] Reference to studies of Danish worker in P. Woldstedt (1929), p. 182.

of the waters of the North Sea, which was soon followed, however, by northern and then arctic conditions. But another more important series is that of the Eemian Sea. This has been found on Dutch and Danish coasts and on the W. and E. Prussian (Lower Vistula) Plain. It includes a few northern types (*Mya truncata, Cyprina Islandica*) and several more southerly ones. These latter are now characteristic of the waters N. and S. of the English Channel (e. g. *Lucina divaricata, Cardium tuberculatum*, etc.), of the French Atlantic coast (*Mytilus minimus, Syndesmya ovata*) and of the Mediterranean itself (*Mytilus lineatus, Tapes senescens* Dod. = *Tapes Dianæ* Loc.)[1]. Such a mixture clearly indicates a migration of southern types northwards during a period of increased temperature in the waters of the N. E. Atlantic. Unfortunately it is not possible to fix the date of these formations stratigraphically, owing to the complicated differential changes of level on the above mentioned coasts and to the effect of subsequent ice, sea and sub-aerial denudation[2]. The majority of workers, however, seem now to accept that they were laid down during the last Interglacial (Saale-Weichsel)[3]. As it is clear that the Skärumhede series of N. Jutland is more recent than the Eemian beds, the latter should inevitably be confined to the earlier part of that Interglacial. This would again add to the evidence that the Saale-Weichsel Interglacial had two distinct warm sub-phases.

That the preceding (Elster-Saale) Interglacial was long and warm throughout is now almost generally accepted[4]. This, as we shall see later, is supported by evidence from many parts of the Old World. In C. and N. C. Europe the best data come from the so-called *Paludina diluviana* Bank in the neighbourhood of Berlin. Both its fresh water molluscs and its flora indicate very temperate conditions much similar to, if not slightly warmer than, the present time[1]. This was the so-called warm Pleistocene fauna (*Elephas antiquus, Rhinoceros Merckii*, etc.) *par excellence* over C. Europe. It can be best distinguished from the following Interglacial (Saale-Weichsel) by the fact that whereas during the latter, the mammoth roamed over both C. and S. Europe (mixing with southern fauna), it was limited during the Elster-Saale Interval to Scandinavia alone[2]. It may, in fact, be safely concluded that, taken as a whole, the Elster-Saale Interglacial had a less variable and perhaps slightly more genial climate[3], than the following one in N. C. and N. Europe.

Eastern Europe.

Conditions in E. Europe and the Russian Plain during the Ice Age have been the subject of much intensive study during recent years. It is almost certain that the last glacial phase there (equivalent of Weichsel) was smaller in extension than the two preceding ones[4]. It probably had two maxima separated by an Interstadial[5]. As we have already pointed out, the sheet

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[1] Ch. Depéret (1922*a*), p. 1503.

[2] According to one school these formations belong to the Elster-Saale Interglacial [see e. g. Ch. Depéret (1922*a*), p. 1503], while according to another they fall into the following one [see e. g. P. Woldstedt 1929, pp. 139-141 and 182, where a discussion of the controversy as a whole is also made].

[3] See particularly such works as V. Nordmann (1928) and R. Galon (1934), pp. 107-108.

[4] An important authority who does not agree with this view, however, is H. Breuil. He regards this internal (in the Lower Somme) to have been warm, then cool and then again warm (see H. Breuil and L. Koslowski, 1931, p. 476). In dating this interval, however, he appears to depend chiefly on archæological evidence. This method, while being of immense help in the dating of Pleistocene formations, is not always safe. By analogy with conditions along the whole of the N. European Plain, this interval of the Middle terrace of St. Acheul (with its three-fold division into warm, cool and warm) coïncides with the Saale-Weichsel rather than with the Elster-Saale Interglacial. We may also add here that there is no reason to accept G. S. Simpson's largely theoretical suggestion that conditions were cold right through the Elster-Saale Interval and warm right through the Saale-Weichsel (on account of suggested change in solar radio-activity). See G. S. Simpson (1929), pp. 23-33 (1930), pp. 272-273 and (1934), pp. 446-459 and 468-470.

[1] P. Woldstedt (1929), pp. 129-130 and 290. Also work of Th. Schmeirer (1922).

[2] C. E. P. Brooks (1922), p. 60. On mammoth also *vide infra*, p. 29 footnote 5.

[3] This is, however, only a generalization. Conditions during short parts of the Saale-Weichsel Interval may have been even warmer in N. Europe than during the Elster-Saale.

[4] Probably the snow line was so high in E. Europe during this last glaciation that the Urals missed it. See P. Woldstedt (1929), p. 283. We may note, on the other hand, that this last phase is regarded by certain authors as the greatest one on Russian lands. See reference to controversy in P. Woldstedt (1929), p. 206.

[5] P. Woldstedt (1933), pp. 383-384 and Table I on p. 378, prepared after W. Krokos who attributes one small bed of loess in the Ukraine to each of the two maxima. This division, however, raises some difficulties as the Weichsel proper of N. Germany, the accepted equivalent of this last

of the Saale (*"vorletzte Glazialzeit"*) was more extensive on this part of the European Plain than that of the Elster. The various glacial stages of Russia have now been carefully worked out and each associated with a loess formation [1]. There is even a very old loess which is taken to represent a fourth and still older glaciation [2]. This latter is interesting, but it may have only been a cold phase corresponding to that we referred to on the N. W. fringes of the European Plain (*vide* Tale III). The question of the relative strength of the two main Interglacials (Saale-Weichsel and Elster-Saale) is still the subject of discussion in spite of the existence of various lacustrine formations (especially to the S. of Moscow) which may have been largely due to the melting of ice during interglacial phases. The climatic conditions during the last Interglacial (equivalent of Saale-Weichsel) are a matter of controversy. Some workers regard it as having been rather warm [3], but there are indications in the North of a boreal transgression in this phase [4]. The present tendency among students of this Interval in Eastern Europe is to regard it as having had three sub-phases (warm, cool and warm again) as in N. Germany proper [5]. The first Interglacial (equivalent of Elster-Saale), on the other hand, is best represented in C. Russia by lake deposits with warm flora incorporated in them [6]. There are also formations with *Paludina diluviana* and other warm fresh-water fauna in the Dnieper valley

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glaciation of Russia, could not be divided into two maxima. (See Woldstedt, 1933, p. 384.) It seems, therefore more likely that the Russian Interstadial mentioned above corresponded to the Daniglacial Retreat, and the second maximum to the Late-Glacial stadial phases of Scandinavia. It should be noted however, that the re-advance of the Russian ice during the second part of the last glaciation could not have been connected with the Late-Glacial ice-sheet of N. W. Europe as the latter was confined to Scandinavia and Finland. The last loess bed of the Ukraine may have corresponded simply to a cold phase in N. Russia. All these remain open matters.

[1] The contemporaneity of the five Ukrainian loess layers with glacial conditions (the first with a pre-Elster glaciation and the last two with two Weichsel maxima) has been suggested by W. I. Krokos (1931), pp. 43-62 and (1932), pp. 1-4; see also P. Woldstedt (1933), p. 382.

[2] See references as in note above.

[3] See E. Antevs (1934), p. 150.

[4] See P. Woldstedt (1929), p. 205 and Table 5 on p. 207.

[5] P. Woldstedt (1933), p. 376.

[6] P. Woldstedt (1929), pp. 205-206.

similar to those of the *Paludina* Bank near Berlin [1]. We may, therefore, on the whole, speak of a general correspondence between E. and W. Europe during the various phases of the Ice Age.

In the extreme North of Inner Eurasia the story of the Post-Glacial and Glacial phases is less known; but it offers some interesting points worthy of recording. There is evidence from various parts of N. Siberia of a recent phase of warmth which preceded the establishment of the somewhat cooler conditions of the present day. North of the Ural Mts. birch remains occur between two beds of till far north of the present range of this tree [2]. Similar indications of a recent (Post-Glacial) phase of warmth come from the New Siberian Islands [3]. The episodes of the Ice Age itself, however, are less clear, and it seems that a great part of C. and W. and S. W. Siberia was under water during most of the Pleistocene [4]. The evidences we have from the New Siberian Islands, N. E. Siberia, Kamatchatca, Mongolia, etc., seem to indicate two clear phases of glaciation (represented by two fossil ice series in the New Siberian Islands), separated by a well marked interval during which conditions were warmer than the present ones [5]. The first of these two glaciations was much more powerful than the second; but it seems that none of them exhibits any sure signs of more than one maximum. It is quite

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[1] P. Woldstedt (1933), p. 377. There are also similar *Paludina* Beds attributed to the same Interglacial in Poland (neighbourhood of Warsaw); see work of St. Rozycki (1929), also reference in K. Piech (1932), p. 64 and P. Woldstedt, *ibid.*, p. 377. The existence of the same warm formations of *Paludina diluviana* in the same stratigraphic level in Germany, Poland and Russia may be therefore taken as a special feature of the Elster-Saale Interglacial.

[2] E. Antevs (1928), p. 6.

[3] Part of this phase in the Islands was one of submergence. Marine clays were formed in a climate somewhat warmer than the present. See C. E. P. Brooks (1922), p. 80.

[4] See especially G. F. Wright (1902), vol. 2, pp. 498 et seq. and map facing p. 496; also his article (1901), p. 248. See also P. Woldstedt (1929), pp. 205-206.

[5] Like the Post-Glacial warm phase, this Interglacial was also marked by the northward spread of flora and fauna (meadow vegetation, shrubs, alder and white birch together with mammoth and rhinoceros). See E. Antevs (1928), pp. 6-7, C. E. P. Brooks (1922), pp. 78-80; also P. Woldstedt (1929), p. 286. [In this respect, it may be useful to add that while the spread of the mammoth into the extreme N. of Siberia indicates relatively warmer conditions, its spread in the direction of C. and S. Europe points rather to cooler conditions than at present; also compare *supra*, p. 27 footnote 2.]

possible, however, that each of them corresponded to more than one glaciation in W. Europe. The interval between them must have been very marked to have led to the complete melting of the ice-sheet in this region where extremely low temperatures must have accompanied the ice phases. It would therefore be reasonable to correlate it with the Elster-Saale Interglacial of the N. European Plain. In this case the first Siberian glaciation would correspond to the Elster glaciation and the Pre-Glacial phase, while the second one could be equated with both the Saale and Weichsel (including the Late-Glacial stadia) glaciations[1].

Before we descend to lower latitudes, an attempt may be made at a general correlation of conditions along the Northern Belt of Eurasia. This may be given in tabular form as follows:—

[1] This is already the view held by E. Antevs, P. Woldstedt and C. E. P. Brooks (*ibid.*, as in notes above). The fact that the Saale-Weichsel Interglacial was relatively short and interrupted by a cool sub-phase makes it difficult to correlate it with the important Interglacial of Siberia.

Correlation along N. Latitudes of Eurasia.

TABLE IV.

Tentative general correlation of climatic conditions in Post-glacial and Glacial times along the Northern Belt of Eurasia. (Based on works cited for Tables II and III and referred to in footnotes on pp. 27-30 for E. Europe.) (The Table reads upwards and no time-scale is attempted.)

PHASES.	BRIT. ISLES.	N. W. EUROPE AND N. GERMANY.	E. EUROPE (POLAND AND RUSSIA).	N. SIBERIA.
Recent.....	?	Cooler (Twilight of Gods)	?	Cooler
Post-Glacial.	Warm	Warm (Climatic Optimum)	Warm?	Warm
Late-Glacial.	Hessle glaciation. Retreat with one stadium in N. England and perhaps a later one in Scotland.	Retreat with stadia over S. Baltic and Scandinavia	Retreat with last glacial re-advance (5th Ukranian Loess?)	II Siberian Glacial
Last Glaciation	III Glacial (Little Eastern)	Weichsel (including Warthe stadium?)	Weichsel proper (4th Uk. Loess?)	
2nd Interglacial phase.	2nd Interglacial (warm, cool and warm)	Saale-Weichsel Interval (warm, cool and warm)	Saale-Weichsel Interval (warm, cool and warm)	
II Glaciation.	II Glacial (Great Eastern)	Saale (with Warthe stad.?)	Saale (3rd Uk. Loess)	
1st Interglacial phase.	1st Interglacial. Warm-temperate	Elster-Saale Interval. Warm	Elster-Saale Interval. Warm	Siberian Interglacial. Warm
I Glaciation.	I Glacial (N. Sea)	Elster	Elster (2nd Uk. Loess)	I Siberian Glacial
Pre-Glacial warm phase.	Warm phase of Forest Bed	Temperate	Temperate	
Pre-Glacial cold phase.	*Refroidissement* in Crags	Cold or Glacial (in parts)	Cold or Glacial (1st Uk. Loess)	

We need not comment on the above given correlation in any detail; but we should at least point out certain important points which would be of considerable and indispensable help in the study and correlation of climatic

changes in lower latitudes (Alpine, Saharan and even Equatorial). These may be briefly enumerated as follows:—

A. Interglacial climates.

(1) The Post-Glacial phase was a warm one (warmer than the present day) all along the Northern Belt.

(2) The period of the retreat of the ice during the Late-Glacial phase was on the whole, cooler than the present day, and it was interrupted by stadia.

(3) The Saale-Weichsel Interglacial had three sub-divisions (warm, cool and then warm) throughout the whole of this N. Belt. This is perhaps the most significant feature of the Interglacial climates of Northern Europe.

(4) The Elster-Saale Interglacial had, on the other hand, more stable conditions. It also represented a more protracted genial phase, though at its very beginning conditions may have been still cool.

(5) The Pre-Glacial warm phase is not marked everywhere, although on the extreme western border of the N. European Plain it was fairly warm.

B. Glacial climates.

(1) The Retreat of the ice was not regular and the number of stadia not the same everywhere. Local conditions (especially in Scandinavia, where the number of stadia is the highest) must have played an important part.

(2) The last glaciation was apparently the least extensive of all.

(3) The Saale was the most extensive glaciation on the W. and E. stretches of the N. European Plain, but the Elster exceded it in S. Germany and S. W. Poland. The Saale may be further stated to have been chiefly a "Plain" glaciation, while the Elster was a "Mountain" one (most pronounced in Scandinavia). The Saale had a subsequent stadium (the Warthe); which certain authorities consider as an advance phase of the Weichsel.

(4) The Pre-Glacial cold phase is fairly well marked in England, N. W. Germany, Scandinavia, Poland and Russia. It may have been, however, only a phase of *refroidissement* not amounting to a glaciation in the proper sense.

GLACIAL EPISODES ALONG THE ALPINE BELT OF EURASIA.

Pyrenees and Massif Central.

We must now deal with the Alpine Belt of Eurasia. Besides varying in elevation, these mountains run mainly from W. to E., (*i. e.*, in the same direction in which air and moisture currents penetrate the continent), and local variations in their climatic record must therefore be expected. The Pyrenees, on the extreme West, offer an interesting case. In Post-Glacial times we have evidence (from analysis of peat formations) of a phase which was warmer than the present [1]. The climates prevailing during the glacial and interglacial phases proper, however, have not been sufficiently worked out as yet [2]. But on the whole, three definite phases of glaciation could be traced with certainty, though an earlier one is sometimes mentioned [3]. The latter two of these glaciations were less extensive than the one that preceded them; but the frontal moraines of the three are associated with a terrace-system in the rivers at the northern foot of the mountains [4]. Unfortunately it is not possible as yet to distinguish between the relative strengths of the Interglacials.

In the Massif Central of France, the story of the climatic phases of the Ice Age is very similar to that of the Pyrenees. Three main glaciations (also associated with terraces) and an earlier one (less clearly marked) are discerned [5].

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[1] H. Gaussen (1926) and (1933), p. 747.

[2] On the glaciation of the Pyrenees see the works of A. Penck (1883), Fr. Wiegers (1913), pp. 384-417, H. Obermaier (1921), pp. 158-162 and Ch. Depéret (1923), pp. 1519-1524. It appears that the details of glacial oscillations in the Pyrenees were somewhat obliterated by the moderating effect of the Ocean.

[3] Fr. Wiegers (*Idem*) distinguishes four glaciations and correlates them with those of the Alps which we shall presently mention. Ch. Depéret (*Idem*) sees only three which he correlates with the latter three of the Alps.

[4] These terraces are at 55-60 m., 29-35 m., and 18-20 m. above the bottom of valleys. See Ch. Depéret (1923), p. 1524.

[5] Ph. Glangeaud (1921), p. 121.

The Alps.

The Alpine region proper was the first to be systematically investigated along this belt [1]. In fact the work of Penck and Brückner there has served as a classic for workers not only in the Alps but also outside them. We find it, however, of little use to go into any of the details upon which the conclusions of these writers are based, as these latter have been in the main confirmed by posterior studies. We know from plant evidence that the Post-Glacial phase was more genial than the present day especially in summer [2]. The last stages of glaciation were marked by repeated advances (or rather halts) and retreats (Daun, Gschnitz and, before that, Bühl stadia), which could be traced on both slopes of the Alps [3]. Before that there were four main glaciations. The last of these, Würm (the smallest), is thought to have had two maxima, though the second of these appears to have been less significant and the distinction between them not very clear [4]. The comparison between the two preceding ones (Riss and Mindel) is rather interesting. Riss represented the maximum glaciation only for the Swiss Alps in the North, while Mindel was the most extensive one over the rest of the Alps [5]. This throws useful light on the question of the correlation of glaciations in the Alps and N. Europe. The Northern Swiss Alps are more intimately connected (climatologically) with the N. European Plain and their maximum glaciation is

(1) This is thanks to the work of A. Penck and Ed. Brückner (1909). For good summary of various studies in the Alps see P. Woldstedt (1929), pp. 227-246, where mention is made of the various formations associated with glacial and interglacial phases.

(2) A. V. Hayek (1910), p. 115. According to A. Penck and Ed. Brückner (1909, p. 1145) the Ice Age was probably brought to an end through an increase in the summer temperature. See also Ed. Brückner (1910), pp. 106-107. For a comparative study of Post-Glacial climatic changes in the Alps and other parts of Europe see work of H. Gams and R. Nordhagen (1923).

(3) Apart from work of A. Penck and Ed. Brückner (1909), see also K. Troll (1925), pp. 281-292 for the N. slopes and T. Tamarelli (1910), pp. 75-77 for the Italian side.

(4) A. Penck (1922), pp. 214-251 and (1925*a*), pp. 349-371; also references in P. Woldstedt (1929), p. 242 and (1933), pp. 383-384, M. C. Burkitt (1933), p. 90 and H. Peake and H. J. Fleure (1927*a*), p. 4.

(5) On this point see P. Woldstedt (1929), pp. 244-245; also work of A. Heim (1919). There are also some other differences between the E. and the W. Alps, upon which we need not dwell here.

more likely to have occurred simultaneously with the greatest extension of the ice-sheet over the latter [1]. In this respect it is interesting to recall that the Riss glaciation is believed to have had two *maxima,* especially in the Western Alps [2]. On the other hand the Mindel glaciation was more typically "Mountainous" in its extension, and would therefore make a more likely equivalent of the maximum glaciation over the Scandinavian ranges (the Elster). The earliest glaciation, the Günz, was apparently a smaller phase, as its traces are not recognizable everywhere in the Alps. According to the unanimous opinion of French workers, it certainly is missing from the Alps of France [3]. In other parts of the Alps its traces were much obliterated by later phases.

Interglacial Phases in the Alps.

The question of the Interglacials in the Alps is perhaps a much more delicate one. Little is known about the conditions during the phases of the retreat of the ice during Late-Glacial times, but it seems that even during the Achen phase (the most important retreat between the Würm and the Bühl) conditions were not quite genial (in spite of the rise of summer temperature). A strong controversy also exists regarding the Riss-Würm as compared with the Mindel-Riss Interglacial. Although there is almost general agreement that the former was the shoter one, Alpine workers do not agree amongst themselves regarding the details of its climate. The deposits Dürnten, Wetzikon, Flurlingen, etc., indicate warm conditions [4]. Their flora includes

(1) This might have taken place during a period when the precipitation brought by Westerlies penetrating along the N. European Plain was especially pronounced.

(2) B. Eberl (1928), pp. 107-117; also P. Woldstedt (1929), p. 369. B. Eberl (*Idem*) even goes as far as to regard the 2nd max. as having beeu stronger in the Werstern Alps. At any rate it is interesting that the greatest glaciation of the N. European Plain may have also had two phases of advance, the Saale proper and the Warthe stadium (unless this latter is placed at the advance phase of the Weichsel, *vide supra,* p. 22, footnote 1 and table III).

(3) See e.g. M. Boule (1908), pp. 7-9 and Ch. Chaput (1923), pp. 1519-1520; also reference in H. Peake (1922), p. 6.

(4) See W. B. Wright (1937), pp. 164 and 166-167 and P. Woldstedt (1929), pp. 232, 243 and Table 7 on p. 245.

Brasenia purpuria, Acer pseudoplatanus, Buxus sempervirens, etc., whilst amongst their fauna we find *Elephas antiquus* and *Rhinoceros Merckii*. In spite of the wide distribution of these formations, however, it is not possible to work out the oscillations of climate during this interval, as has been done for the last Interglacial in N. Europe. But the fact that such relatively cold plants as *Pinus montana* and *Salix reticulata* have been found with other warm plants in the Riss-Würm formations of the Vigezzo Valley[1] may indicate that warm conditions were not uninterrupted. This is, however, only a suggestion. The most important—and perhaps also most discussed—interglacial formation of the Alps is the deposit of the Hötting Breccia[2]. It contains the remains of the southern species of *Rhamnus höttingensis* and *Rhododendron ponticum*. The former is a relative of the *R. latifolia* now living in the Canaries while the latter now grows only in the Pontic region of the Caucasus with remnant survivors in the Sierra Nevada and Portugal[3]. They must therefore represent a period of more genial summers, and a mean annual of some 3° C. higher than the present. A. Penck attributes this deposit to the Mindel-Riss, while J. Murr places it in the succeeding Interglacial[4]. The question is not settled as yet, but the recent tendency amongst workers in the Alps is to accept Penck's conclusions[5]. In fact, it may be safely assumed that the Mindel-Riss Interglacial was a much more protracted and better marked interval than either the Riss-Würm or the Günz-Mindel, which preceded it. The latter is not well marked, because its formations have been almost wholly eroded. It may have been only a short interval.

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[1] See W. B. Wright (1937), 168.

[2] On this deposit see W. J. Sollas (1924), pp. 26-28 and P. Woldstedt (1929), pp. 136-138 and W. B. Wright (1937), p. 166.

[3] On the former see W. B. Wright and W. J. Sollas as in note above. For former and present distribution of *Rh. ponticum* see map in G. Andersson (1910 *d*).

[4] See A. Penck (1921) and J. Murr (1926); also reference to this old controversy in P. Woldstedt (1929), pp. 136-138 and 291-292.

[5] See reference by Sölch in discussion at Bristol meeting of Brit. Ass. for the Advanc. of Sc. (see H. J. Fleure 1931), p. 379. Also P. Woldstedt (1929), pp. 291-292, and F. Machatschek (1930), pp. 7-8.

Tatra Mts.

East of the Alps the question of glaciation was studied in the Tatra Mts. chiefly by E. Romer (1929) and B. Halicki (1930)[1]. The former distinguishes four glaciations, while the latter admits the existence of only three —omitting the first of Romer[2]. The last glaciation—the smallest—was probably only represented by three comparatively small oscillations[3]. The relative strength of the two preceding ones is not sufficiently clear; but at least in certain places, where the evidence could be adduced, the earlier one of the two was somewhat stronger[4]. As to the very early glaciation of Romer, there is not sufficient evidence to prove its existence, and it may have been only a phase of refrigeration. Neither Romer nor Halicki ventures any correlation with the Alps, but the analogy between the last glaciation of the Tatra, on the one hand, and the Würm and its succeeding recession-phases in the Alps, on the other, is clear. The preceding two glaciations of the Tatra may have corresponded to the Riss and the Mindel. The existence of an equivalent to Günz in the Tatra remains an open question.

Evidences relating to the formations of the two interglacial phases of the Tatra (especially the S. slopes) are given by Halicki[5]. The last Interval (between the last-but-one and the last Glacials) had two formations, one of

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[1] We do not propose here to go into details relating to glaciation in the mountains of Bohemia (Czechoslovakia), where, for some reason or other (unknown as yet), only traces of the last glaciation, and perhaps the one before, could be found. Various explications of this may be put forward. See F. Vitásek (1934), pp. 38-40.

[2] For this suggested first glaciation see E. Romer (1929), pp. 213-214. For evidences against its existence see B. Halicki (1930), pp. 521-522 [also reference in his work (1932), p. 15]. Reference to this controversy also in J. Smolenski (1934), p. 70. The present writer has had the chance of visiting the site of the supposed moraine of this oldest glaciation near Szaflary (Up. Dunajec); and it seems that this formation must, at any rate, be related to a cold phase. Its upper part shows traces of stratification (beds of large gravels) which may support Halicki's argument that it is a flurio-glacial deposit. It is by no means certain, however, that it is not older than the first glaciation of Halicki.

[3] E. Romer (1929), pp. 73-74. According to B. Halicki (1930, pp. 531-532) the retreat of the ice from Tatra had three (and in some cases even five) phases.

[4] E. Romer (1929), p. 37. See also J. Smolenski (1934), p. 12.

[5] B. Halicki (1930), pp. 527-528.

which (apparently the later) indicating definitely genial conditions (with *Quercus pedunculata, Acer pseudoplatanus* L., etc.), while the other must have been deposited under humid and only relatively temperate conditions (with *Betula pubescens, Salix cinerea* and *Pinus silvestris*). This latter formation may be correlated either with a retreating phase of the second Glacial (last-but-one) or with a relatively cool phase within the Interglacial. In either case it would be interesting to compare this with conditions in the Alps and N. Plain during the retreat of the second Glacial and the last Interglacial. The formation relating to the first Interglacial of the Tatra indicates warm and dry climate, with short and less rigorous winters. It includes *Betula verrucosa* Ehrh., *B. pubescens* Ehrh., *Nymphæa lotos* L., *Rhamnus frangula* L., etc.

The Caucasus.

The story in the Caucasus has been shown by A. v. Reinhard (1925/1926) to be very similar to that of the Alps. The final recession of the ice was marked by three stadia which recall Daun, Gschnitz and Bühl [1]. The glacial phases proper were three or perhaps four in number [2]. As in the case of the Alps the last Interglacial but-one was by far the longest and most genial one [3].

Innermost Asia.

Continuing the Alpine latitudes Eastwards, we get to the Plains of Turkistan and the mountain-blocks of C. Asia. Unfortunately the story here is much less clear. Some authors would think that in recent geological times (Post Tertiary), the plains of Turkistan and S. Russia were under water [4]. This inland water surface had access probably both to the N. Ocean and the Black

[1] A. v. Reinhard (1925-1926), pp. 118-125.

[2] In this case, however, it is the last and not the first of the four that was not clearly marked. See A. v. Reinhard (1925-1926), pp. 92-98.

[3] A. v. Reinhard, *ibid.*, pp. 97-98.

[4] See especially G. P. Wright (1901), pp. 248-249 and (1902), pp. 498 et seq.; also P. Woldstedt (1929), p. 206.

Sea; which explains the existence of species of Arctic seals in Balkash and the Caspian, on the one hand, and the very low degree of salinity of the W. C. Asiatic lakes, on the other [1]. The extent of the water covering in this region during Pleistocene times seems to have been exaggerated by G. F. Wright [2], but it is quite probable that the waters melting from the ice-sheet (especially in C. and N. Russia) have led to the formation of extensive lakes in S. Russia and Turkistan. As to the factor of precipitation, it is interesting to note that although traces of former glaciations have been found on some of the mountains of the heart of Asia, these latter were by no means as extensive as the glaciations on the other mountains, lying near the periphery of the land-mass. In fact, in the Altai [3], and in the Romanov mountains [4], in W. Turkistan reliable evidence of only one glaciation has so far been found, while in the Pamirs [5], all evidence of a former greater extension of glaciers appears to be lacking. This makes it probable that during the Glacial stages of the Ice Age few moisture-bearing currents could find their way to the heart of Asia, as they were shut off by the almost continuous girdle of glaciation [6]. Innermost Asia must then have been cold and dry. Yet it is clear from P. Fickler's work that the lowering of the snow-line in the Altai was due to greater precipitation from winds coming in the same direction as those which bring moisture at the present time [7]. Only during a period of exceptionally powerful air currents, corresponding to abnormally low pressure over C. Asia, could the single glaciation of the Altai have taken place.

[1] G. F. Wright (1902), pp. 503-504. Another possible explanation of the existence of Arctic species in the Caspian, however, may be that they were driven southwards in lakes in front of the Ice sheet advancing from the N. Seas over the Russian Plain, without there having been a direct waterway between the N. Ocean and the Capsian. See A. G. Högbom (1916-1917), pp. 241-260; also P. Woldstedt (1929), p. 206.

[2] See his map facing p. 496 in his (1902), vol. II.

[3] P. Fickler (1925*a*), p. 633.

[4] See reference in F. Loewe (1924), p. 53; also E. Antevs (1928), p. 6, footnote 1.

[5] R. Finsterwalder (1932) as reviewed in *G. R.*, April 1933, p. 342.

[6] One possible (and important) "gap" was probably the Iranian Plateau, where the extension of glaciers was comparatively negligible, and evidences of pluvial rather than glacial phases have been forthcoming.

[7] P. Fickler (1925), p. 128 and (1925*a*), p. 633. Also E. Antevs (1928), p. 28.

We, therefore, venture to think that this took place during the largest Interglacial of the Pleistocene, and which, according to wider correlations (to be attempted later on), divided the whole of the Ice Age into two main sections.

The Himalayas.

Before we try to put together the facts known about the different parts of the Alpine Belt, a short review must be given of conditions in the Himalayas [1]. According to the work of G. Dainelli, four main glaciations occured in the Upper Indus and were followed by a small succession of minor oscillations (stadia) [2]. The last of these glaciations was very small, while the one preceding it was only a little more pronounced. The first two glaciations were on the other hand much greater and may have been of more or less equal

[1] We do not propose to deal at present with the problem of climatic changes in the extreme East of the Asiatic Continent. Besides being very little known, the climatic record of this region appears to have been much affected by local factors. It would, therefore, throw little light on the problem of climatic correlations at which our present treatment aims. We may mention, however, that according to recent work by Davidson Black and others in N. China (1933, pp. 50-60) there have been in recent geological times (from Up. Pliocene onwards) three physiographic cycles connected with climatic changes. The last of these cycles is characterized by the deposition of the Yellow Loess. The one before it is associated with the well-known Choukoutien deposits, while the first one is identified with the Sanmenian phase (Up. Pliocene). No serious attempt is made by these workers to correlate their formations with the climatic changes in Europe, but the suggestion is made that the Loess may be "broadly Würm" and that the second cycle may have been the equivalent of the late Mindel (*ibid.*, p. 59). Against this latter suggestion, however, stands the fact that the Choukoutien deposits coïncided with a period of warmer conditions than the present (see *ibid.*, pp. 61-62). We shall return to this question in the following Part of this work, when we deal with the culture-zone of the Asiatic Steppe as compared with that of the Saharo-Arabian Area. It may be useful for the present, however, to mention that according to the theme we are now trying to the work out, the last and the first of these three cycles would correspond to the main sections of the Ice Age as a whole, while the middle one would be equated with the warm Interglacial separating them (*i. e.*, the long M.-R. and its equivalents) and during which precipitation appears to have been high over the interior of Asia,—causing erosion in this latter region and deposition in N. China proper (*vide* also *supra* on the Altai Mts.).

[2] G. Dainelli (1922), pp. 599 et seq., particularly pp. 638-642. See also F. Loewe (1924), pp. 42-53.

extension, though it is thought that the snow-line was slightly lower during the first one [1]. According to Dainelli, the glacial period of the N. W. Himalayas seems to have been preceded (in late Tertiary times) by a preparatory phase of fluvio-glacial activity [2]. Recent work in the Himalayas has on the whole confirmed the conclusions of Dainelli in regard to the number of glaciations [3]. Further material, with regard to Interglacial phases has also been forthcoming, though the evidence relates rather to the physiography and crust movements than to the climatic character of these intervals [4].

As for the correlations between Himalayas and Alps, the suggestions made by Dainelli are still accepted. He regards the Post-Glacial oscillations of the Himalayas as well as the fourth glacial phase as being all equivalent to the Late- and Post-Glacial oscillations in the Alps (Bühl onwards). The Third Glacial is equated with Würm and the first two with Riss and Mindel [5]. We are not in a position to discuss these equations, but, so far as the relative volume of each of these glacial phases is concerned, they seem to be in full harmony with conditions on the various chains of the Alpine Belt [6].

Correlation of Climatic Changes along Alpine Belt.

In the following table an attempt is made at a general correlation of climatic changes in different parts of the mountain belt of mid-northern latitude.

[1] G. Dainelli (1922), p. 638. It should be noted, however, that this is not accepted by recent workers in the Himalayas. H. de Terra (1934, p. 41 and 1939, p. 102) finds that the Second Glaciation was at least slightly greater than the First one as it was the most powerful in old drainage channels.

[2] G. Dainelli (1922), p. 634.

[3] See H. de Terra (1934), pp. 12-41 and (1939), pp. 102-105; also G. E. Hutchinson (1934), pp. 87-88. E. Trinkler (1932, as reviewed in *G. R.*, April 1933, pp. 342-343) accepts the existence of only two main glaciations.

[4] We know now that there were four main phases of uplift and dissection in the Himalayas (in Pre-Glacial and Post-Glacial times as well as during the two main Interglacials). See H. de Terra (1934), p. 41.

[5] G. Dainelli (1922), p. 635.

[6] It should be made clear, however, that until climatic conditions during the Interglacial phases have become better known, it would be difficult to prove or disprove these equations.

TABLE V.

Tentative correlation of climatic changes during post-glacial times along the Alpine belt. Based largely on references mentioned in footnotes on pp. 33-41. (The Table reads upwards, and no time-scale is attempted.)

STAGES.	PYRENEES.	ALPS.	TATRAS.	CAUCASUS	C. ASIATIC Mts.	HIMALAYAS
	Warm		?	?	?	?
Late- and Post-glacial.....	Stadia?	Daun, Gschnitz, Bühl — Rising temperature(?)	3 stadia or more.	3 Stadia	?	stadia.
	?	Achen retreat	Retreat?	Retreat	?	Retreat
Glacial.....	3rd Glacial	Würm (I and II).	3rd Glacial	4th Glacial (?)	?	3rd Glacial.
Interval....	2nd Interglacial	R.-W. Warm but probably interrupted with cool conditions.	2nd Interval with warm but probably interrupted conditions.	3rd Interglacial	?	2nd Interglacial
Glacial.....	2nd Glacial	Riss. Max. in Swiss Alps (with later stadium).	2nd Glacial	3rd Glacial	?	2nd Glacial
Interval....	1st Interglacial	M.-R. Long, warm and not interrupted.	1st Interval. Warm and apparently not interrupted.	2nd Interglacial. Long.	Extension of glaciers in Altai?	1st Interglacial. Long.
Glacial.....	1st Glacial	Mindel. Max. over rest of Alps.	1st Glacial. Max.	2nd Glacial (Max.?)	?	1st Glacial (Max. ?)
Pre-Glacial..	1st Interglacial	G.-M.	?	1st Interglacial.	?	?
	Early cold or glacial phase?	Günz. In C. and E. Alps only.	Early cold or glacial phase?	1st Glacial	?	Fluvio-glacial phase

The conclusions drawn from this table may be briefly summarized as follows :

(1) In Post-Glacial times there was a tendency towards warmer conditions (than the present day). This is particularly clear in the Pyrenees and the Alps.

(2) The oscillations of glacial stadia were a general feature during the final retreat of the ice along the whole of the Alpine mountainous Belt.

(3) Only two real Interglacials could be distinguished; the R.-W. and the M.-R. of the Alps. Both of them were warm; but the R.-W. appears to have been interrupted by a cooler sub-phase (which is difficult to fix). On the other hand the M.-R. was not interrupted.

(4) The last Glacial (Würm) was the smallest, while Riss represented the maximum glaciation in certain spots (particularly N. Switzerland). But taken as a whole, the Mindel was (by a small margin) the strongest of all. Riss may have had a later stadium during its retreat (especially in Switzerland).

(5) The Günz glaciation was not a general feature. It appears to have been represented only by a phase of refrigeration (*refroidissement*) and fluvio-glacial activity in many parts of this belt.

CORRELATION BETWEEN N. EUROPE AND ALPS.

We may now devote a few words to the general correlation between the extreme Northern and the Alpine latitudes. Together they form the N. climatic zone whose story was intimately connected with that of the Saharan Belt to the south. There is now general agreement amongst workers in Europe that the glacial stages of the Alps were parallel to those of the North [1].

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[1] We may note, however, the objection to synchronism recently raised by Cosmo Johns (1934*a*), pp. 70-75 and (1934*c*), pp. 408-424 on purely hypothetical grounds. He thinks that during glaciation in the North, the Alps were in an Anticyclonic (dry) zone, while the Saharan Belt was rainy. The Glacials of the Alps occurred during Interglacials in the N. and Interpluvials in the Sahara. Physiographic evidence in Europe lends no support to this assumption. Furthermore, it is difficult to assume that the development of the ice-sheet in the North was so sudden that it led to the rapid envelopment of the Alps in an anticyclonic zone before its snow-fields and glaciers could increase.

This is largely based on physiographic and morphological evidence (river-terraces, stratigraphy of formations, etc.) as well as on data provided by prehistoric archaeology. It should be noted, however, that, unless considered over a very wide area and with sufficient care, the correlation of the details from various localities is not entirely safe. But beginning from proto-historic and Post-Glacial times we have a good starting point. From the comparison of Tables IV and V we find that the rise of temperature during this phase was general all over W. and N. Eurasia. Such a wide phenomenon must have been synchronous. The actual retreat of the Ice was oscillatory and had at least three chief stadia in the lands where it had an important sheet. The last Glacial proper was on the whole the smallest. The last Interglacial (R.-W.) was comparatively short; and it appears to have been interrupted (nearly everywhere) by a cooler sub-phase of some description. The Glacial preceding it had a very great extension especially on the N. Plain and some adjoining mountains. The earlier Interglacial (M.-R.) was very long and uniformly warm or warm-temperate. The Glacial which again preceded it represented the maximum glaciation for the Scandinavian block and the main part of the Alpine chains. It was preceded by an interval which may have been warm here and there, but which seems to have followed on a phase of gradual *refroidissement* whose traces have been found in many lands ranging from the British Isles to the Himalayas. This synchronism may be briefly summarized in tabular form as below :

TABLE VI.

General correlation between glacial and interglacial phases in the Alps and N. Europe. (Based on references as mentioned for Tables III, IV, and V.) (No time-scale is attempted.)

STAGES.	ALPS.	N. EUROPE.
Post-Glacial.	Warm.	Warm (Climatic Optimum).
Late-Glacial.	Daun, Gschnitz and Bühl stadia and Achen Retreat.	Ragunda Pause, Fenno-scandian and Gotiglacial stadia and Daniglacial Retreat (with stadia)*.
Glacial.	Würm (I and II).	Weichsel (including Warthe?).
	R.-W. Interglacial.	Saale-Weichsel Interglacial.
	Riss (with later stadium?).	Saale (with later Warthe stadium?).
	M.-R. Interglacial.	Elster-Saale Interglacial.
	Mindel.	Elster.
Pre-Glacial. .	G.-M. Interglacial.	Warm or warm-temp. phase.
	Günz.	Earliest cold phase (Glacial)?

(*) We need not go here into details of the correlation between the phases of the Late-Glacial in the Alps and N. Europe, which were probably more complicated than first appears. The fact that Scandinavia had an "ice-sheet" proper, while the Alps had only remnants of extended glaciers, would make us expect the existence of some minor differences between the two. It seems safe, however, to suggest the correlation between the Achen and the Daniglacial Retreats. See also E. Antevs (1928), pp. 161-162.

LATITUDE S. OF EUROPE. THE MEDITERRANEAN.

Raised Beaches (and Associated Deposits) and Past Climates.

We must now turn to the latitudes south of Europe. The Mediterranean constitutes a climatic zone of its own, though, in a way, it represents the transition between Europe proper and the now arid belt of the Sahara. The story here is not sufficiently clear as yet, but it throws very useful light

upon the problem of climatic correlations. An interesting line of research is afforded by the study of marine formations in Quaternary and late Tertiary times. De Lamothe (1899 and 1911) in N. Africa, M. Gignoux (1913) in S. Italy and Ch. Depéret (1900 and 1918*a*) in S. France, have distinguished a number of beaches indicating higher levels and different conditions of temperature in the waters of the Mediterranean. According to Depéret's classification in the W. Mediterranean [1], these beaches lie at 18-20 metres, 28-32 metres, 50-60 metres, and 90-100 metres above the present sea-level. A lower level at some 8-9 metres may be regarded as a step of the 18-20 metres beach, while higher levels at 150, 204, 265 and 325 metres were probably earlier than the period with which we are dealing in the present work [2]. These levels must have had a wide distribution, probably all round the Mediterranean, but were subsequently disturbed by differential land movements in various parts of the basin, such as S. Italy, the Ægean and other places in the E. Mediterranean [3]. They can be dated in relation to each other not only by their height but also through the help of palaeontological data afforded by remains of mollusca included in them. That the lowest of these beaches was the youngest and the highest the oldest is clear from physiographic evidence. The levels are so well preserved that we are forced to assume that there has been a gradual (though irregular) decline of the level of the water from Up. Pliocene times onwards [4]. From the work of de Lamothe, Boule and others it is clear that the fall of the waters from one level to the other may have been at first marked by a recession to a lower level than at present prevails; but the subsequent rise never attained a higher or even the same water-mark as before [5]. In other words, there

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[1] Ch. Depéret (1918*a*.), p. 481 and (1921), p. 125.

[2] Some workers would take the levels 8-20 metres as forming one beach. See D.A.E. Garrod (1928), p. 45. We shall see a little later that this is quite reasonable. Levels higher than 100 metres do not appear to have the same regularity or wide distribution as those between 20-100 metres.

[3] See e. g. M. Gignoux (1913), pp. 632-634; Ch. Depéret (1913), pp. 430-431 and 1048 and (1918), p. 485; L. Cayeux (1911), pp. 1796-1798; and B. Ž. Milojević (1933), p. 48.

[4] M. Gignoux (1913), pp. 14-15; see also M. Boule (1906), p. 144.

[5] See M. Gignoux (1913), fig. 1 on p. 15.

has been in late-Tertiary and Quaternary times a succession of oscillations with successively decreasing maxima of water-level. From the regularity of these beaches and their fairly wide distribution, it is clear that they were due to eustatic factors, although, as we have just mentioned, epeirogenic variations might have been of some importance locally [1]. The majority of workers now tend to think that during the glacial phases of the last Ice Age the accumulation of a large body of water, in the form of ice, over the continents must have led to the recession of the waters of the oceans, while during the interglacial phases the opposite must have taken place [2]. It is estimated that the volume of ice during the climax of the last glaciation (which we know to have been the smallest of the three main glacial phases) in excess of the existing quantity of land-ice in the N. and S. Hemispheres was about 37,000,000 cubic km. of ice, which would have lowered the general level of the oceans by some 90-95 metres [3]. The gradual lowering of the maxima reached by the high-water levels of the oceans [4] during

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[1] Reference to the controversy concerning eustatic and epeirogenic factors in M. Gignoux (1913), pp. 633-634.

[2] See particularly E. Antevs (1928), pp. 74-82. Ch. Depéret, on the other hand, (1921, pp. 125-127) associates the four main levels of the beaches with terraces of approximately the same levels (18, 30, 60, 100 metres) in the lower and upper courses of rivers in the W. Mediterranean and more particularly in France, which he in turn, equates with the four glaciations of Penck and Brückner in the Alps [although he himself (see Depéret 1923, p. 1524) admits only three glaciations in the Pyrenees]. It may be noted, in this respect, that although the formation of Terraces in the lower courses of rivers may have been largely governed by changes in base-level, that of terraces in the upper parts of rivers could hardly have been affected by such changes. The latter terraces could be attributed only to other factors, amongst which the changes in climate and in the power of the stream (in erosion and deposition) were the most pronounced. Only such terraces, however, could be safely correlated with glacial phases. The broad equations of Depéret appear therefore to be far fetched, and we shall touch presently, on another (perhaps safer) method of dating the raised beaches, and to a less extent, the terraces associated with them.

[3] See E. Antevs (1928), p. 81. The synchronism in glaciation between the extreme N. and S. of the globe may not have been absolute in all its details, but alternation of glaciation between the two Hemispheres is practically out of the question (see E. Antevs 1928, p. 13; also *vide supra*, pp. 8-9.

[4] The fact that the Strait of Gibraltar has apparently been open (except perhaps for a short and very doubtful interval) since the close of the Tertiary [see R. Vaufrey 1929 *a*. p. 19, footnote P. Pallary 1921 pp. 348-351 and 1923 p. 290; also L. Gentil 1909, pp. 1227-1228 and D.A.E.

Quaternary times may be at least partly accounted for by the changes in land and sea distributions over the globe. It is probable, according to Peake and Fleure that huge masses of land in the N. Atlantic and in S. E. Asia have been depressed below sea during the very recent phase of geological history [1]. The disappearance of such land masses would presumably lead to the extension of water surface and the lowering of the mean level of the oceans.

The dating of these raised beaches of the Mediterranean can perhaps be most safely approached if we start from the lowest, and most recent, levels and proceed to the highest, and oldest, ones—much in the same way as we did with the land-formations of Europe. We may note at first that the beaches fall into two main groups : the lower one constituted of the so-called Monastirian (18 metres with its lower lovel at 8 metres) and Tyrrhenian (30 metres) beaches, and the higher which includes the Milazzian (60 metres) and the Sicilian (100 metres). The lower group is characterized by warm fauna (warmer than the present), while the higher one had N. Atlantic and Lusitanian species which must have lived in colder waters than at present prevail in the Mediterranean. It should be made clear, however, that malacological fauna is capable of surviving through successive geological subphases in spite even of slight changes in water-conditions. The Monastirian and the Milazzian phases may have therefore been periods during which species introduced into the Mediterranean during the Tyrrhenian and the Sicilian phases (respectively) survived. This indeed seems to have been the case, at least in so far as the Monastirian is concerned. The real changes in the temperature of the Mediterranean waters appear to have taken place

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Garrod (1928) p. 47] excludes the possibility that the lowering of the mean water level was limited to the Mediterranean.

[1] See H. Peake and H. J. Fleure (1927), p. 77 for probable changes in the N. Atlantic and (1927), p. 60 and (1927 *c*), p. 198 and Fig. 109 on p. 185 for changes in S. E. Asia. It is believed that the topography of the shallow Sunda Strait suggests that it was apparently carved at a time when the water stood at some 73 metres lower in relation to the land. See G.A.F. Molengraaff (1921), pp. 100 and 116; also E. Antevs (1928), p. 82. The fact that there are indications of recent progressive uplift in the mountains in Indo-China (see J. (?), Depras, 1911, p. 1528), suggests that the extreme S.E, fringes of the Continent were depressed by isostatic agencies. Also reference to Quaternary sinking of land in the Gulf of Mexico in C.E.P. Brooks (1926), p. 88.

only during the Tyrrhenian (when Tropical and Sub-Tropical species spread northwards) and the Sicilian (when Arctic and Lusitanian species migrated to Middle latitudes). It is, therefore, of special importance from our present point of view to attempt to define the place of these two phases in the recent geological history of the Mediterranean.

The fauna of the lower group (Monastirian and Tyrrhenian) [1] includes species living living now on the coasts of the Senegal, Guinea, the Isles of Cap Verde and the Canaries. These are *Strombus mediterraneus* (= *Strombus bubonius* Lmk., the species which gave its name to the whole group), *Mytilus senegalensis* Reeve, *Cardita senegalensis* Reeve, *Arca Geissei* Dunk., *Natica lactea* Guild., *Natica Turtoni* Smith, *Tornatina Knockeri* Smith, *Conus testudinarius* Martini and *Tritonidea viverrata* Kiener. Others, now absent or very rare in the Mediterranean but still living in the temperate waters of the Atlantic include : *Pecten maximus* L., *Venus fasciata* da Costa, and *Tapes rhomboides* Penn. And finally another set of species of this group still lives in the Mediterranean, but only in its warmest parts. It includes : *Spondylus gæderopus, Cassis saburon, Panopæa glycymeris* etc. During the later phase of this group (*i.e.* the Monastirian) the warm species became limited to the Algerian coasts of the Mediterranean, while only species less characteristic of the group lived on the coast of France [2]. It seems that already at this phase there was a difference in water-temperature between the S. and the N. coasts of the Mediterranean. During the Tyrrhenian phase, on the other hand, the tropical species were spread all over the Mediterranean; and their remains are found as far East as Cyprus and the Syrian coast [3]. A similar distinction may be drawn between the two phases of the higher group. Owing to the rarity of characteristic

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[1] For species of this lower group see M. Gignoux (1913), pp. 606-607 and Ch. Depéret (1918 *a*) pp. 484-485. Also references to the expansion of tropical species into the Mediterranean in P. Pallary (1907), pp. 421-425 and (1923), pp. 280-281.

[2] Ch. Depéret (1918 *a*), p. 485. In the 8 metres beach below the Devil's Tower Rock-shelter at Gibraltar only one specimen indicating warmer waters occurs. This is *Ocinebra Edwardsi* Payr., which recalls a modern variety living in Madeira. See P. Fischer (1928), p. 113.

[3] See M. Boule (1906), p. 137; also Ch. Depéret (1918 *a*), p. 485 and M. Blanckenhorn (1914) pp. 36 and 52.

specimens from the Milazzian beach, the fauna of this stage has never been sufficiently worked out. It is known to include, however, *Tapes rhomboides*, *Modiola modiolus* L., *Venus fasciata* Da Costa, *Balanus concavus*, *Pecten pesfelis* and *Triton nordiferum*, all of which are now either living (or represented by closely similar species) in the Mediterranean itself or in the temperate Atlantic [1]. Some of these species appear to be descended from the Pliocene fauna of the Mediterranean [2]. According to Ch. Depéret, the development in the size and ornamentation of some of these species indicates rather warm or temperate conditions [3]. But M. Gignoux, who made a special study of the formations and faunas of the Mediterranean, finds no reason to think that it was a warm phase [4]. It appears, in any case, that we are dealing with a phase not very different from the present day and with no traces of the really warm fauna of *Strombus bubonius*. The Sicilain phase, on the other hand, had a real Arctic fauna. It was marked by a great migration of northern types to the Mediterranean [5]. According to Gignoux, this migration started in a so-called Calabrian phase (in the Up. Pliocene), which, in his opinion, preceded the Sicilian in S. Italy [6]. The palaeontological distinction between the two phases, however, is imperceptible, as they have practically the same fauna [7]. In fact, both Calabrian and Sicilian are represented by a single cold phase outside S. Italy. The most important species that they have yielded include : *Chlamys islandicus* L., *Cyprina islandica* L., *Mya truncata* L., *Panopæa norvegica* Speng., *Trichotropis borealis* Brod. and

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[1] On this fauna see M. Gignoux (1913), p. 605 and Ch. Depéret (1918 *a*) p. 484.

[2] The species of *Cancellaria piscatoria* Gmel, from the 60 metres beach at Oran, and which is believed to have arrived from Senegalese waters, may simply represent an autochthonous species evolved from the local Pliocene fauna. See M. Gignoux (1913), p. 326.

[3] Ch. Depéret (1918 *a*), p. 484; see also W. J. Sollas (1924), p. 35.

[4] M. Gignoux (1913), pp. 605, 626 and 630-631.

[5] On this migration and the difference between the L. and the Up. Pliocene fauna as illustrated in S. Italy, see M. Gignoux (1913), pp. 596-602; F.W. Harmer (1926), 32-33 and G. d'Erasmo (1934), p. 95.

[6] M. Gignoux (1913) pp. 21-25.

[7] The chief distinction being the disappearance in the Sicilian of more species of the Pliocene and the appearance of a larger number of Northern immigrants. See Ch. Depéret (1918 *a*), p. 483. The distinction in S. Italy is really more physiographic than faunistic.

Sow., *Pecten maximus* L., *Mactra solida* L., etc. [1]. As should be expected, however, these extremely northern immigrants have preferably spread along the N. coasts of their new habitat. The Sicilian fauna of the N. African coast is much less characteristic of this phase [2].

As we have already mentioned, the lowest level of the Monastirian lies at 8-9 metres above the present sea-level. Fortunately this level can be well dated through archaeological data. Excavations by D. A. E. Garrod at the Devil's Tower Rock-shelter (Gibraltar) have revealed the fact that, on its emergence from the sea, this level was covered by the following succession of formations [3] (No. 1 being the highest) :

(1) Fine sand filling the fissures to the roof.
(2) Calcareous tufa 1-4 metres (with some blocks from the roof).
(3) Fine sand 20 cm.-1 metre.
(4) Travertine, 10-80 cm.
(5) Fine sand, 40 cm.-1 m. 40.
(6) Travertine, 50-75 cm. (with many blocks derived from the roof).
(7) Raised beach, with its surface at 8 m. 50-9 metres above the sea.

Layers 6-1 must have been formed by the blowing of sands by wind into the rock-shelter [4]. It is believed that the conversion into tufa and travertines of layers 6, 4 and 2 was due to the presence of a calcareous spring —now dried up—which alternately flowed and ran dry, in harmony with climatic changes [5]. This would mean that following on the emergence of the land there were three wet phases at the Gibraltar Point. There is no reason to think that there was any long interval between the emergence of the land and the deposition of layer 6; and it seems that Upper Mousterian man (whose industry was found right through layers 5-1) reached the

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[1] Of these, only a few species such as *Trichotropis borealis* and *Panopæa norvegica* appear only in the Sicilian, indicating that the migration from the North reached its maximum during this phase. On this fauna see M. Gignoux (1913), pp. 496-605 and Ch. Depéret (1918 *a*), p. 483.

[2] Ch. Depéret (1918 *a*), p. 483.

[3] D.A.E. Garrod (1928), pp. 37-44 and Figs. 3 and 4 on pp. 39 and 41 respectively.

[4] D.A.E. Garrod (1928), p. 45.

[5] D.A.E. Garrod (1928), p. 47.

Devil's Tower Rock-shelter shortly after the recession of the sea [1]. This is of special importance from the chronological point of view, as there is now general agreement amongst prehistorians in Europe that the L. Mousterian belongs to the close of the Riss-Würm Interglacial and the Upper Mousterian to the Würm glaciation [2]. There is therefore every reason to think that the recession of the sea from the Monastirian beach of Gibraltar coïncided with the extension of snow- and ice-fields over various parts of Europe (and other parts of the world) during the Würm glaciation.

The same conclusions may be also drawn from the study of the formations at the caves of the Côte d'Azur. Among these, the Grotte du Prince, at Grimaldi, is the most typical [3]. Its floor lies on the same 8 metres beach as the Devil's Tower Shelter. Its archaeological formations are in two main sections : the upper, with an Upper Palaeolithic industry (well represented in other caves) and the lower, with typical Mousterian (and perhaps also Acheuleo-Mousterian) [4]. The Upper Palaeolithic is accompanied by a particularly cold fauna including the *Vulpes Lagopus* L. (*"Renard bleu"*) and the Reindeer. The Mousterian (which, it should be noted, is of a fairly advanced facies), on the other hand, is associated with a distinctly warm fauna, with *Elephas antiquus, Rhinoceros Merckii* and *Hippopotamus amphibius* [5]. It should be made clear, however, that in virtue of its geographical position, this corner of the Ligurian Sea enjoys particularly favourable climatic conditions; and there is no reason to think that, even during glacial phases, it was not relatively more favoured than other parts of S. Europe. The warm fauna, driven from the N. by the advance of the last glaciation (the time of the typical Mousterian) could find refuge in this region, in which it survived

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[1] D.A.E. Garrod (1928), pp. 45-46. Also on the industry see *Idem*, pp. 48-54.

[2] As we shall see in the following Part of the present work, the main differences between the two Schools of Long and Short Chronology concern the relative date of the Chellean-Acheulean succession and not that of the Mousterian.

[3] See M. Boule (1906), pp. 119-127 and (1927), pp. 31-35 and 87-104.

[4] See M. Boule (1927), pp. 91-113; also reference in R. Vaufrey (1928) pp. 78-79.

[5] For the cold fauna see M. Boule (1927), pp. 67-73; for the warm one see *ibid.*, pp. 87-88 and 103-104.

till ultimately replaced by the cold fauna [1]. It would therefore appear quite safe to assume that the archaeological levels of the Monaco-Grimaldi caves were built up during the advance and the maximum of the last glaciation (taken as a whole). The beach which immediately preceded them would consequently belong to the last Interglacial.

The climatic oscillations which followed on the deposition of the 8-9 metres step of the Monastirian beach, and which we have already seen in Gibraltar, may be confirmed by evidence from S. Italy. The Romanelli Cave (whose floor lies on the 8 metres beach) has yielded the following series of formations (most recent at top) [2] :

(1) Dark brown clay with thin beds of silicious sands.
(2) Hard stalagmitic sheet (patchy in places).
(3) Reddish-brown clay with thin beds of silicious sands.
(4) Very hard stalagmitic formation pressing of the lower beds.
(5) Calcareous bed derived from the decaying roof (and with angular blocks).
(6) Same as layer 5, but with somewhat rounded blocks.
(7) The floor of the Cave merging into the beach (the latter containing also blocks derived from the roof).

Of course in a cave like the Romanelli, where water could percolate through the roof only under increased precipitation, the two stalagmite beds would indicate a higher rainfall [3]. The upper stalagmite bed (layer 2) corresponds to a later phase which, however, was not so pronounced as the one before it. Layers 7-4 correspond to one major wet phase, which apparently had two sub-maxima; a later one during which the stalagmite covering (layer 4) was formed, and an earlier one which had already begun at the close of the deposition of the beach which contains blocks from the decaying

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[1] In this respect, it may be pointed out that *Rh. Merckii* is one of the most resisting members of the warm fauna. On its persistence from warm into cold and even glacial phases see R. Vaufrey (1928), pp. 72-74.

[2] See works of G.A. Blanc (1920), pp. 65-103; also R. Vaufrey (1928), pp. 87-92. It is clear that the beach level here has not been much affected by land-movements since the recession of the sea.

[3] See R. Vaufrey (1928), note 3 on pp. 92-93.

roof[1]. These phases would correspond fairly well with the three wet phases of Gibraltar[2].

Evidences relating to the 20 m. step of the Monastirian beach are also available from the African coast. On various points on the coast of Oran and Algiers an interesting succession of formations capping this beach has been found[3]. This is best illustrated at Karouba (near Mostaganem) where we find the following sequence of layers[4] :

(1) Present moving dunes.
(2) Æolian sand-stone recently concreted.
(3) Washed gravels (*cailloux de ruissellement*).
(4) Second calcareous sheet.
(5) Yellow sand with *Helix*.
(6) First calcareous sheet.
(7) Yellow and reddish sand-stone with *Helix* and containing typical and evolved Mousterian (Atirian) implements of quartzite and flint.
(8) The raised beach 18 m.

There seems to be little doubt that Mousterian man reached N. Africa (apparently through Europe, as we shall see in the following Part of the present work) shortly after emergence of the 18 m. beach[5]. Unfortunately the nature of the formations covering the beach has never been sufficiently worked out, and it is difficult to argue for climatic changes upon the evidence as it stands. Layers 4 and 6 may perhaps be thought to represent somewhat

(1) See R. Vaufrey (1928), p. 92-93.

(2) A similar succession of climatic changes has also been established by A. C. Blanc (1936) for the coastal plain of Lower Versilia (Toscania). See reference in R. Vaufrey (1939), p. 404 and Fig. 13.

(3) See P. Pallary (1911), p. 162; F, Doumergue (1922), pp. 183-224; L. Joleaud (1931*a*), pp. 487-488 and (1933), p. 15; also D. A. E. Garrod (1928), p. 46.

(4) On this and other sites see L. Joleaud (1931*a*), note 30 on p. 488; also work of F. Doumergue (1922), pp. 183 et seq.

(5) This may in itself lend strong support to the view that the 8 metres and the 18 metres levels are practically one and the same beach. A similar difference of 10-12 metres is also found in other beaches, particularly the 50-60 metres and the 90-100 metres ones. The suggestion that the 8 metres step is slightly older than the 18 metres one (*i. e.* that it was deposited during a halt in the rise of water-level before it reached the 18-20 metres mark) is not feasible, as wherever it is found the 8 metres step is well defined.

drier(?) and warmer(?) phases during which capillary action helped the formation of calcareous beds. This would mean that following on the emergence of the beach, there were three pluvial sub-phases, separated by two drier ones. But it may be argued with equal (or more) strength that layers 4 and 6 rather represent an increase in rainfall, which, coupled by a temperature similar to that of the present day, would be equally favourable for the formation of tufas, travertines and calcareous concretions. Whatever the case may have been, it is safer to leave this as an open point.

From the evidences we have so far surveyed, it appears that, at least in the W. Basin of the Mediterranean, the sea receded from the Monastirian beach (8-20 m.) during the advance of the last glaciation (Würm). The deposition of this beach belongs therefore to the last Interglacial (Riss-Würm). Unfortunately, it is not possible, in the present state of our knowledge, to apply a similar process of dating to the preceding beach—the Tyrrhenian. It has been noted, however, that this latter beach had a particularly warm (tropical) malacological fauna; and it would therefore be unthinkable to attribute it either to a glacial phase or to a cool interglacial. The slight differences in species and the marked difference in the distribution of the fauna as a whole (*vide supra*, p. 49) make it equally difficult to attribute it to the same interglacial as the Monastirian beach. Between the deposition of the Tyrrhenian and that of the Monastirian beach the sea receded and it never recovered the 30 m. level afterwards. The recession must have lasted for a certain time to account for the above mentioned differences[1]. On this indirect, but sufficiently strong evidence it would not seem possible to avoid the conclusion that the Tyrrhenian beach was laid down during the chief Interglacial of Europe (the Mindel-Riss and its equivalent in the N.) and that the recession which followed it coïncided with the Riss Glacial. We have already seen (*vide supra*, p. 42-43) that this Interglacial was a long and genial phase, which, in a way, marked the division between the two main

(1) This recession probably reached a lower level than that of the present day. It certainly was lower than the Monastirian levels. The fact that there is no definite beach between the Tyrrhenian and the Monastirian indicates that during this recession, the sea could not have halted for any appreciable time at an intermediate level.

parts of the Great Ice Age. In the Mediterranean too, it marked an important turning-point in its malacological history.

The two other beaches of the Mediterrenean (the Milazzian and the Sicilian) are, and must remain a puzzle. They are not directly, or even indirectly, associated with any archaeological remains that might give a hint as to their possible age. Theoretically they should preferably fall within two interglacial or non-glacial phases when the sea waters were high. Such phases (or at least the earlier one), however, must have been characterized by cold seas. These two beaches were also probably followed and separated from each other by a phase of recession during which changes took place in the malacological fauna. We have already pointed out (*vide supra*, p. 46) that physiographic evidence is strongly in support of the fact that the Milazzian beach immediately preceded the Tyrrhenian in the succession. This makes it highly feasible that the former was laid down in the pre-Mindel Interval and that the recession which followed upon it coïncided with the Mindel glaciation. The Sicilian beach, on the other hand, is more difficult to date. Its cold fauna is generally regarded as belonging to the so-called "Upper Pliocene" of S. Italy (*vide supra*, p. 50). It must have been laid down during a phase of "*refroidissement*". The spreading of arctic species towards the Mediterranean indicates that this "*refroidissement*" was of more than local significance. By analogy with N. Europe this phase may be said to fall somewhere within "Pre-Glacial" times. In view of the largely inadequate evidence, we propose *for the moment* to place it immediately before the Günz (and its equivalents?)[1].

Land Formations and Past Climates.

Turning now to the climatic changes in the Mediterranean Basin as indicated by land formations, we find again that the evidence is very fragmentary. Besides the oscillations that we have already seen in Gibraltar and S. Italy and which correspond roughly to the last Alpine glaciation (as a whole), older climatic changes are known only in broad outline. Glaciation occurred

[1] It may be safer, however, to equate the Milazzian and Sicilian stages with the lower part of the last Ice Age generally, *i. e.* Pre-Mindel times, without being too accurate about their exact place.

on some of the mountains of the Iberian Peninsula, though the number of the advances of the glaciers is not quite clear[1]. E. Fleury believes, however, that there were in Portugal two main glaciations separated by an interglacial[2]. On the Atlas Mountains, on the opposite coast, glaciation also took place in the Pleistocene, but no detailed work is available[3]. But in Italy the story is somewhat clearer. It appears that there were two main glaciations, the latter of which with two phases[4]. These glaciations (on the mountains) were accompanied by fluvio-glacial and fluvial activity in the valleys. Three terrace-levels could be traced, and these stand in the Apennine valleys of Emilia at the relative heights of 10-15 metres (the lowest and most recent), 30-40 and 70-80 metres[5]. These terraces are correlated by Italian workers with the three main glaciations in the Alps; and it is thought that interglacial (and interpluvial) phases were marked by erosion[6]. M. Gortani thinks that between the two main physiographic cycles (the first corresponding to the Alpine Mindel and the second—with its two phases—to the Riss and the Würm), there was a marked uplift of the land[7]. In fact

[1] See H. Obermaier (1921), pp. 158-162 and (1928), pp. 336-339; also reference in E. Antevs (1928), p. 35.

[2] E. Fleury (1916), p. 401.

[3] L. Gentil (1924), pp. 31-35 and Emm. de Martonne (1924), pp. 296-302. See also P. Woldstedt (1929), p. 287; E. Antevs (1928), p. 35; H. Obermaier (1930), pp. 253-254 and G. E. P. Brooks (1932), p. 63.

[4] See M. Gortani (1928), pp. 27 and 40; T. Lipparini (1934), pp. 37-40; also work of G. De Lorenzo and G. Dainelli (1923).

[5] See T. Lipparini (1934), p. 38.

[6] See T. Lipparini (1934 *a*), pp. 1-2 and (1934), pp. 2 and 38; also M. Gortani (1928), p. 27. It is not clear from these works, however, whether this applies to the lower as well as the upper parts of the rivers. Changes in base-level would have been of special importance in the formation of terraces in the lower courses, while they would have hardly affected the upper ones. The rise of the sea level during interglacial phases would help the 'deposition' rather than the 'cutting' of the terraces in the lower courses. It should be remembered, however, that interglacial phases were largely characterized by land movements and volcanic activity in Italy, and that an uplift might have nullified (at least locally) the effect of the rise of the base-level. At any rate, the decrease of precipitation during interglacial (and interpluvial) phases might have led to the deepening of their beds by the streams.

[7] M. Gortani (1928), p. 27.

such land movements as well as volcanic activity have characterized most of the Pleistocene in Italy and they certainly occurred also during the last Italian Interglacial (equivalent of Riss-Würm)[1]. This has of course rendered the study of the climatic and physiographic changes in Italy all the more complicated.

To the East of Italy traces of former glaciations have been found in the Balkan Peninsula[2]. It seems that during the glacial period the extension of the ice was more marked on the western side of the peninsula and that the snow-line rose up as one proceeded eastwards[3]. This indicates that the wind and precipitation came from the same direction as at present. Evidences of glaciation have also been found on mountains to the East of the Mediterranean (such as the Lebanon)[4], but these will be dealt with later on, when we come to consider the pluvial changes in the arid belt to the S. and E. of the Mediterranean. And finally within the Mediterranean itself, we may note an interesting, though isolated, piece of evidence from the island of Skyros (Greece). In an extensive deposit of calcareous tufa (indicating in this region wetter conditions than at present) were found remains of *Rhododendron ponticum*[5]. The existence of this plant in a Pleistocene deposit of the Mediterranean (for there is no reason to doubt the Pleistocene age of the tufa) indicates that, at least during certain phases, the climate of the Mediterranean was not only slightly less warm(?) than at present, but also had a more plentiful supply of rainfall distributed all the year round[6]. A wet vegetative season (summer) is necessary for the thriving of this plant. This is interesting because it means that during wet phases the increase in the rainfall over the Mediterranean was not simply the result of the intensification of the present climatic régime (with winter rainfall), but a radical change in the seasonal distribution of the

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[1] The moraines of the last glaciation (equated with the Alpine Würm) contain fine volcanic ash indicating activity just before the advance of the glaciers. See R. Vaufrey (1928), p. 37 and footnote 1 on p. 44.

[2] See J. Cvijic (1908), pp. 1-35 and J. Dedijer (1916), pp. 520-521; also reference in E. Antevs (1928), p. 35.

[3] See reference in A. Penck (1914), p. 283.

[4] See H. B. Tristram (1884), pp. xx-xxi; Ed. Hull (1885), pp. 182-183 (1886), p. 114; M. Blanckenhorn (1914), p. 39 and G. Zumoffen (1926) pp. 152-153.

[5] G. Andersson (1910 *d*), pp. 145-149.

[6] See G. Andersson (1910 *d*), p. 149.

rainfall. Furthermore, the existence of *Rh. ponticum* in Skyros indicates that at least during one phase of Pleistocene the island was linked to the mainland. This may by supported by the fact that remains of *Elephas antiquus* have been found in some pluvial deposit in the island of Dilos (Delos) in the Cyclades[1]. It appears that the Ægean land-mass was lifted on the eve of a glaciation (perhaps in this case the Riss?) when the warm fauna and flora of Europe (including *EL. ant.* and *Rh. pont.*) were driven to the south. At some later date the land fell again (or perhaps the sea rose, or perhaps both). But in the present state of our knewledge, this can only be a hypothetical line of thought.

Correlation between the Mediterranean and the Alps.

With only these fragmentary pieces of evidence at hand, it would hardly be possible to correlate the climatic changes of the Mediterranean with those of Europe, though the adjacency to the Alps may be a helping factor. As we shall mention later on (*vide infra*, towards end of present Part), it would seem that during periods when Europe was under severe glacial conditions there was a shift of the climatic zones towards the South. The extent to which the Mediterranean was affected by such a shift is, however, difficult to assess. During the early part of the shift (which in any case must have been fairly gradual) the Mediterranean may have probably enjoyed a climate similar to that of latitudes to the N. of it[2]. But at the maximum of a strong glaciation over the Alps, we should expect the development of an anticyclonic belt over the mountains to the N. and E. of the Mediterranean. This would have its effect upon the power and direction of the wind and might lessen the amount of precipitation[3]. As the Alpine ice faded away and the climatic zones began

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[1] See L. Cayeux (1908), p. 1089 and (1911), pp. 1797-1798.

[2] The factor of the relief which has a preponderant effect upon precipitation in the latitudes to the N. of the Mediterranean may have been partly counter-balanced in the Mediterranean Basin proper by the existence of an internal water surface.

[3] Even during such a phase, however, we should expect a fairly high precipitation in summer. It may even be argued that during a glaciation on the Alps, storminess would be active along the south side of its cold front, *i. e.* over the Mediterranean.

to redress themselves northwards, conditions in the Mediterranean would presumably return (for a while) to what they were before the maximum. This would be interesting to remember in any correlation of the pluvial stages of the Mediterranean with the Glacials of the Alps. We have seen, for example, that the last Mediterranean "Pluvial" (following on the emergence of the Monastirian beach) had, for the most part, three sub-phases which were associated, in general, with typical and advanced Mousterian as well as some Up. Palaeolithic industries. It may perhaps be argued that the last of these sub-phases corresponded to the main "Late-Glacial" advance in the Alps (the Bühl), while the two preceding ones coïncided with the retreat and the advance phases of the Würm Glacial.

Against this, however, stands the fact that anticyclonic activity over the Alpine Belt might not have been strong enough during the Würm glaciation to have affected such relatively remote corners as Gibraltar or the extreme S. of Italy. Furthermore, we should remember, it is equally possible that the two early sub-phases of the last Pluvial of the N. Mediterranean corresponded to the Würm I and II of the Alps (though the distinction between these latter two sub-maxima was not very clear). In this respect we may note that, on the evidence of the Romanelli deposits these two pluvial sub-phases were really two stages of one main sub-phase. Older pluvial phases in the Mediterranean Basin are not sufficiently clear to warrant a reasoned correlation with earlier and stronger glaciations of Europe—a correlation which would help to settle this point. We propose to leave this question till we come to the more general correlations of climatic changes over Middle Latitudes.

LITTLE AFRICA AND THE SAHARA: THEIR CLIMATES IN PLEISTOCENE AND RECENT TIMES.

On the Existence of a Pluvial Period.

The Saharan Belt represents one of the most crucial zones in the climatic régime over the globe. Through climatic changes in recent geological times it has suffered more than any other belt. Increases in the precipitation do not appear to have ever been large enough to give this vast land-surface any thick covering of forest, while changes in the opposite direction, however small they may have been, have always had a marked effect upon its vegetational and animal life. In many parts of the Sahara the actual quantitative value of the change was so small that it left hardly any appreciable traces in the physiography of the country. Furthermore, æolian erosion[1] and a number of other factors (including the absence of a protective vegetational covering, and the general looseness of the material except in cases of calcareous concretions[2]), have in many places obliterated the traces of former pluviations. The result of this is that it is not always an easy matter to reconstruct former physiographic cycles in their details. Although evidences of a better (*i. e.* less arid) climate in the recent geological past have always been fairly clear in certain parts of the Sahara, some of the leading authorities on desert morphology have not been prepared to accept climatic changes on any recognizable scale. Among these J. Walther goes as far as to assert that all the physiographic features of the desert surface could be explained on the ground that rain-storms, similar in power and frequency to those that still occur every few years or so, also occurred in the Quaternary[3]. This is especially supported, *in his view*, by the fact that in the Wadis of the desert there are no definite series of terraces that could be attribued to definite and permanently running hydrographic systems such as might have developped during a pluvial period[4]. In some cases we find terraces only in the upper courses of Wadis and not in their lower parts. Walter's observations, however, seem to have been largely confined to the E. Side of the Sahara, which in Quaternary times received much less rainfall than other parts of the C. Sahara, where we find larger fossil systems

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(1) On this important factor see particularly J. Walther (1912), pp. 164-169.

(2) We may note here, by way of contrast, that loose formations (*e. g.* sandy moraines) in such regions as the N. plain of Europe are not always easily eroded, as the waters percolate through them. On the other hand, loose material in the Sahara is most easily dispursed by wind. The effect of æolian erosion on the Quaternary Wadis of the Sahara (especially in the Libyan section) has been to give them an old appearance, so that they could sometimes be confused with Wadis of an older geological age. The freshness of the Quaternary Wadis, however, is on the whole fairly recognizable.

(3) J. Walther (1891), p. 552.

(4) J. Walther (1891), p. 431.

of drainage, with terraces, etc. This question of the value of the physiographic data relating to recent geological times will be touched upon, in more detail, a little later. Walther also discounts any "cultural" remains (stone implement) that may have been found in the deserts, especially in Egypt, on the ground that they belong to workshop sites of *Steinsucher* which may be of any age and could in no case indicate a climatic change [1]. Needless to add, however, no archaeologist at present accepts this sweeping statement. As we shall see in the following Part of the present work, remains belonging to various stages of the stone cultures have been discovered either *in situ*, in settlement sites or sporadically over the surface in many parts of the Sahara. They nearly all point to climatic conditions differing from those of to-day. The other bio-geographical arguments of Walther against the existence of a pluvial period could no longer be entertained [2]. The study of the extinct as well as the existing fauna and flora of the Sahara has shown beyond doubt that at least during one or more phases of the Quaternary, this arid belt received a more abundant supply of rainfall. The influx of "African" (Sub-Equatorial) animals into the rather mixed zone of Little Africa [3], must have taken place during a phase when there was a thoroughfare through the Sahara. We shall see a little later that there was not only an influx of mammals but also of fishes, crocodiles, etc., which still live in residual forms in particularly favourable spots along the route [4]. The intermediate zone of the Hoggar mountains has also received plants migrating from both the Sudan and the Mediterranean coast [5]. It seems, therefore, that, unlike the physiographic features which have been obliterated or masked by subsequent æolian activity in many parts of the Sahara, the palaeontological and palaeobotanic evidence lends very valuable help in the

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[1] He evidently considers all the factory sites of the Egyptian deserts to belong to proto-historic and early historic times. He also draws the parallelism between the "*Steinsucher*" of the antiquity and the "*Goldsucher*" (Gold Prospectors) of modern times. See J. Walther (1912), pp. 94-95.

[2] J. Walther (1891), pp. 542-543.

[3] On the mixed nature of the fauna in N. Africa see P. Pallary (1923), pp. 280-290; see also A. S. Romer (1928), pp. 92-123.

[4] See general reference in E. F. Gautier (1923), pp. 48-52 and E. Antevs (1928), pp. 35-36.

[5] See Ed. Bonnet (1912), pp. 513-516 and R. Maire (1928), pp. 1680-1682.

reconstruction of the conditions in the Sahara in post-Tertiary times. In fact the existence of a Pluvial Period is now established beyond doubt; but the questions of whether it was a single phase or had several sub-phases, and whether it coïncided exactly with climatic changes over more northerly latitudes, are still unsettled. We propose to deal with the first of these questions as we go on, leaving the latter to final correlations at the end.

Little Africa. Evidences of Past Climates (Pleistocene and Recent).

Let us now start with the N. W. corner of Africa. Here we have a chain of mountains which has always had a marked effect upon the climate of this region as distinct from adjacent desert-plains to the S. and S. W. of it. There is reason to think that this effect was still more marked during the Great Ice Age, when climatic zones were apparently shifted southwards. As we have already mentioned, these mountains attracted enough solid precipitation to form glaciers during one or more phases of the Quaternary [1]. There are other indications that the lower plateaux and plains of Little Africa have also shared in the increase in precipitation. Unfortunately we do not know as yet the details of the climatic oscillations here to the same extent as we do for Europe and the Mediterranean. Only a tentative general outline can therefore be given here. Starting from recent times we have indications of a fairly wet phase in the Neolithic culture stage [2]. Neolithic implements and other remains (chiefly arrow-heads of various types, grinding stones and pottery) have been found round dried-up springs

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[1] See L. Gentil (1924), pp. 31-35 and Emm. de Martonne (1924), pp. 296-302. Also E. Antevs (1928), p. 35 and C. E. P. Brooks (1932), p. 63. Up to recent years, however, some authorities believed that no glaciation has ever taken place even on the highest of the Atlas Mts. See reference in S. Gsell (1921), p. 53.

[2] We do not propose to enter here in the chronology of the "Neolithic" cultures of N. Africa. This will be touched upon (though only incidentally) in the last Section of the present work. Suffice it to mention here that, although Neolithic cultural elements seem to have persisted and survived in the interior of Sahara (so that we might get a "Neolithic" station in plain historic times), the early Neolithic cultures ("*Néolithique ancien*") may not have been far removed chronologically from the Neolithic and early Eneolithic stages in the Near East.

and in other places now impossible for settlement [1]. Animal remains from that period also point to better climatic conditions. Although the abundance of ostrich eggs would rather indicate the extension of grass-lands [2], the appearance of *Elephas africanus* (presumably for the first time) [3], *Cervicapra rudunca Maupasii* (reed-buck) and *Cobus unctuosus lunata* (water-buck) and the reappearance of *Hippopotamus amphibius* must have coïncided with the existence of running streams and fresh water pools [4]. If part of the much-discussed rock-drawings and engravings including elephants, hippopotami, big buffaloes (*grand buffle*), lions, panthers, gazelles, sheep, etc., were neolithic [5], they could also be interpreted as indicating better climates. It appears therefore that the Neolithic stage in N. Africa was definitely less arid than the historic phase following it [6]. This contrasts with the Upper Palaeolithic (Capsian etc.) which was, on the other hand, marked by increasing desiccation. We shall see in Section ii of Part II of the present work that this desiccation had a marked effect upon the dispersal of cultures of that time. A number of animals requiring a fairly abundant supply of rainfall, and which appear earlier in Pleistocene, "skip" over the Upper Palaeolithic phase and reappear in the Neolithic. These include the cerval panther, bear, wart hog, hippopotamus, buffalo, reed-buck, eland and ass [7]. Their extinction or emigration from the country is another proof of progressive dryness. In the preceding stages of the Pleistocene proper, the fauna was

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[1] See A. Bernard (1921), p. 68.

[2] See S. Gsell (1921), p. 53.

[3] Remains of the African Elephant from the Upper Palaeolithic are very much doubtful. See A. S. Romer (1928), p. 131; also L. Joleaud (1933*a*), pp. 485, 492 and 494. On the origin of this elephant see L. Joleaud (1928), pp. 6-9. The degenerate descendants of this elephant continued in N. Africa right to Roman times. See Gsell (1921), p. 77 and E. F. Gautier (1923), p. 50.

[4] See A. S. Romer (1928), pp. 131 (on El. and Hippo) and 14-15 (on reed- and water-Bucks).

[5] The controversy of the age of these drawings will also be touched upon later on in the present work. See H. Obermaier (1930) p. 271; A. Bernard (1921) p. 70 and S. Gsell (1921) p. 54.

[6] To this Neolithic wet phase in also attributed the Tirs soil of W. Morocco, which contains bones of *El. Africanus* and had on its surface remains of neolithic appearence but probably of later age. Rich semi-forest vegetation is largely responsible for the formation of this fertile soil. See J. Bourcart (1933), pp. 825-826.

[7] On this point see A. S. Romer (1928), pp. 131-132.

much richer though it is unfortunately not possible to trace its history and migrations in any detail. We know that, taken as whole, it included : *Elephas meridionalis* (apparently only in the Up. Pliocene), *El. Atlanticus* (representative of *El. Antiquus* in Europe), *El.* cf. *melitensis, El. iolensis; Rhinoceros simus mauretanicus; Rh. Mercki subinermis; Hippopotamus hipponensis* (very old, presumably close of Pliocene), *Hip. amphibius; Felis leo; F. ocreata, F. serval; Hyaena crocuta, H. striata; Ursus libycus; Sus scrofa, S. phacocheroides; Hipparion* (very old, presumably close of Pliocene), *Equus Burchelli mauretanicus* (identical with the Mousterian horse of the Castillo cave in N. Spain?), *Eq. asinus africanus; Cervus elaphus barbarus, C. algericus; Camelus dromedarius; Buffelus antiquus, Bos primigenius mauretanicus, Bos taurus ibericus; Bubalus boselaphus; Gazella dorcas, G. Cuvieri. G. dama;* and *Canis aureus* [1]. The members of this assemblage, though not all living at one time, indicate an abundance of rainfall and in some cases a temperature different from the present one. A. S. Romer takes the appearance of a group of animals including *Rh. Mercki* (evidently an intruder from Europe, perhaps *via* Palestine) [2], in the latter part of the Pleistocene (Mousterian phase here) to indicate rather cooler conditions [3]. During the same phase there was an increase in the number of such Eurasiatic animals as the deer, bear, sheep and goat, but the arrival of a number of Ethiopian members is also recorded [4]. As to the animals relating to all the phases of the Pleistocene before the Mousterian, they indicate warm-wet conditions [5]. Only on one occasion are there any

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[1] On this fauna see H. Obermaier (1930), pp. 253-254 and A. S. Romer (1928), table on pp. 160-163.

[2] See R. Vaufrey (1931), p. 263.

[3] A. S. Romer (1928), p. 123. *Rh. Merckii* was an important member of the fauna of Europe during the last Interglacial and the advance phase of the Last Glacial (Würm). Its occurrence in N. W. Africa may therefore have coïncided with cooler conditions than at present. We should remember, however, that this hardy animal could not always be relied upon as an indicator of climatic conditions (*vide supra* footnotes 2 on p. 25 and 1 on p. 53). In any case we may note that the latter part of the Pleistocene was marked by a cold fauna in Europe and (as we shall see a little later) presumably also in Palestine.

[4] See A. S. Romer (1928), p. 130.

[5] It appears, however, that there is a lacuna in the faunistic record of the Quaternary before the Mousterian. J. Bourcart (1933, pp. 825-826 and 1937, p. 438) thinks that during an interval

conspicuous changes in the fauna. During the Chellean phase (equated by L. Joleaud with the Tyrrhenian of the Mediterranean) a number of the above mentioned Eurasiatic animals made their first appearance in N. W. Africa [1]. With this introduction half the total number of N. African fauna was shared in common with that of Europe during the same phase [2]. But this Chellean fauna of N. W. Africa (and whose place in the Pleistocene will be defined in correlations later on) also included such tropical and sub-equatorial animals as the hippopotamus, spotted hyaena, lion and panther and had two-thirds of its members belonging definitely to the "African" group [3]. Some of the types requiring warmth and an abundant supply of water, such as the *Bubalus boselaphus* also appear to have reached N. Africa (presumably from the S.) during this phase [4]. They may indicate wet conditions not only over N. W. Africa but also over the Sahara. The changes which took place in the North African fauna during the latter part of the Pleistocene (Mousterian phase) and at an earlier stage of that period (Chellean or Tyrrhenian) will be interesting to compare with other evidences of climatic changes in other parts of the Saharo-Arabian Belt.

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before the Mousterian but certainly post-Chellean, the climate was very dry (desert), and fairly extensive concretions were formed in W. Morocco. No attempt is made to date this interval beyond saying that it was probably coïncident with part of the Acheulean (perhaps immediately post-Chellean). We shall attempt to find its place in the Quaternary succession more precisely in correlations with other parts of the Saharo-Arabian Belt and also in more general correlations at the end of the present Part. It appears to have been heralded by a phase of volcanic activity and basalt flows in the valleys.

[1] L. Joleaud (1933), pp. 29 and 31. Joleaud, however, places the Tyrrhenian in the Riss-Würm of Europe (see *Idem* p. 2). We have already put forward our reasons for equating it with the earlier Interglacial. *Vide supra* p. 55.

[2] A. S. Romer (1928), p. 128. The rising of the proportion of common types from one third (of the N. African fauna) before the Chellean to one half during that phase appears to have coïncided with an influx of Eurasiatic types into both Europe and N. W. Africa. This may be quoted in support of the fairly common view amongst prehistorians that the Chellean was more or less synchronous in W. Europe and N. W. Africa. In this respect it is interesting to note that the westward spreading of Eurasiatic fauna into Europe could have taken place only during an interglacial phase.

[3] See A. S. Romer (1928), p. 128.

[4] A. S. Romer (1928), table on p. 162. See also reference to the abundance of rain in this phase in J. Bourcart (1933), pp. 822-823 and (1937), p. 438.

Indications of change in the Quaternary climates of the N. W. corner of Africa, other than those drawn from the mammalian fauna are rather scarce. The recent physiographic history of the country is but very little known. In some of the rivers of W. Morocco, particularly the Oum er-Rbia, Zebou and Kiss, there are traces of alluvial and gravel terraces at the relative heights of 5-10 m., 15-20 m., 28-33 m., 52-58 m., and presumably also 100 m. [1]. There can be little doubt that the deposition and the cutting of these terraces were in part controlled by changes in precipitation causing fluctuations in the discharge of streams. At the same time changes in the base-level must be taken into account; and indeed they offer a safer explanation in the present state of our knowledge. Movements in the land-crust during Quatenary times may have also played their part in the history of the river-terraces of this region; but apart from the movements at the Gafsa hills, occurring immediately prior to Mousterian times, none of the recent tectonic phenomena of N. W. Africa could be dated archaeologically [2]. The physiographic evidence from this region is still too scanty and uncertain to be of much practical value for students of recent geological climates.

The best class of evidence from Little Africa comes from the study of fresh-water- and some land-mollusca. This again can be much disputed; but, as it stands, it is one of the few helpful data we possess at present [3]. It is abundantly clear that the fossil aquatic fauna of this region is vastly different from that of the present day. In many places nearly all the species

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[1] See P. Russo (1920), pp. 1511-1512 and (1921), pp. 1187-1188; also E. Passemard (1921*a*), pp. 529-530. It would be interesting to compare these levels with those of the Nile, to which reference will be made in the Appendix at end of present Part.

[2] On the movement in the Gafsa hills see R. Vaufrey (1932), pp. 315-319 and (1933), p. 92. Vaufrey places this tectonic movement (on very good evidence) in the equivalent of the close of the last Interglacial in Europe (Riss-Würm). This will also be useful to compare with movements in other parts of the Mediterranean. On other volcanic activity in N. W. Africa earlier in the Pleistocene see reference in P. Pallary (1921). p. 250 and J. Bourcart (1933), p. 818-819.

[3] The value of land-mollusca in indicating climatic changes is of course very limited. Species are capable of surviving for a very long time and under somewhat varying conditions. Water-mollusca, on the other hand, should provide a fairly safe criterion in judging climatic changes in a country like the one we are dealing with. See P. Pallary (1901), p. 201.

living in running or standing water have been extinguished[1]. The fossil fauna was fairly rich and varied, and it included such large species as *Limnæa palustris* and *Corbicula* sp. resembling types living now in better watered lands in Europe and Asia[2]. Some of the sea-mollusca (such as *Cardium edule*) appear also to have been introduced into some of the old Shotts (apparently by birds and certainly not through channels from the sea). There they lived till the final change in climate led to the gradual drying up of the Shotts and the concentration of the salinity. Now only such species as *Melania tuberculata*, capable of living in particularly salt water, still survive in the Shotts and Sabkhas[3]. The fossil fauna was distinctly palaearctic in character, and it included : *Limnæa stagnalis, L. auricularia, Cardium Lamarcki* Reeve, *Unio littoralis, Neritina* cfr. *baetica* Lmk., *Melanopsis subscalaris* B., *Corbicula Pequignoti* Plry., *Corbicula mauretanica* Plry., etc. Taken as a whole, this assemblage indicates that the climate was more or less favourable right through Quaternary times. There are no indications of any violent extinctions or migrations, though of course this may represent only a negative piece of evidence (*i. e.* that phases of such extinctions have not been traced as yet). At any rate P. Pallary, who studied this fauna, finds that its history falls into four main phases[4]. The present conditions and the extinction of most of the members of the Quaternary fauna date only from proto-historic or even early historic times. The Neolithic which in Pallary's scheme forms the Fourth and last phase (really outside the Pleistocene proper) was warm or warm-temperate and had a more abundant supply of water than to-day. Its fauna included types of *Limnæa, Physa, Planorbis, Melania, Melanopsis* and *Corbicula*[5]. *Cardium edule*, the sea-form appears to have been still living in the Shotts. The Third phase, which represents the Late Pleistocene, was, on the other hand, rather cool. There was an abundance of distinctly Palaearctic forms. Its characteristic fauna included *Conulus Mandraliscii, Zua lubrica, Pupa amblya* and some types

(1) See P. Pallary (1901), pp. 73 and 87.
(2) P. Pallary (1901), p. 79 (quoting P. Fischer, 1894, pp. 366-367).
(3) P. Fischer (1894), p. 367 (quoted by P. Pallary, 1901, pp. 79-80).
(4) On these four phases see P. Pallary (1901), pp. 203-205. (An old, but good, work.)
(5) See P. Pallary (1901), p. 205.

of *Limnæa* together with Helices[1]. This fauna is now extinct even on the higher plateaux and the Tell region, and lives only in small and particularly cool areas. That this phase may have been partly characterized (or presumably separated from an earlier wet phase?) by drier conditions is testified by the existence of breccia capping phosphorite and other formations in the Tell region, and near Algiers[2]. The Second phase differed from the Third in being warm and wet. Its fauna was rich and included types of *Corbicula, Physa, Melanopsis*, etc., while its land shells were not different from those of to-day. At least part of it appears to have been characterized by increased temperature and evaporation, helping the formation of travertines especially round water springs[3]. It is roughly equated by Pallary with the warm mammalian fauna of Palikao (Chellean) and other sites, and with the Mediterranean stage of the Tyrrhenian. And finally the First phase which preceded it was again cooler though also wet. Its fauna had a palaearctic character but it also included warmer types. With *Limnæa stagnalis* and *L. auricularia* we find *Corbicula, Melania* and *Melanopsis*. It seems clear, however, that this phase leads directly from the Upper Pliocene, during which there was a marked change in the fauna as illustrated by the appearance of the cool types of *Hyalinia subincerta, Cyclostoma mauretanica, Helix tlemcenensis*, etc.[4]. This was the conspicuous phenomenon of *refroidissement* which we have seen from many other lands about the same time.

The climatic record of the Quaternary in N. W. Africa as drawn from whatever scanty evidence we have been able to trace, may broadly be stated as follows : The establishment of the present climatic régime is very recent and took place in Post-Neolithic times. The Early Neolithic phase proper

(1) On the fauna of this phase see P. Pallary (1901), pp. 203-204.
(2) It should be made clear, however, that the physiographic position of this breccia is not at all clear. It may have belonged to any moment within that phase. On this breccia see P. Pallary (1901), p. 204.
(3) On these formations as well as the fauna of this phase, see P. Pallary (1901), p. 203. These travertines (requiring warm-wet climate) must apparently have been earlier than the other concretions in W. Morocco, which J. Bourcart associates with very dry climates. *Vide supra* footnote 5 on pp. 65-66.
(4) On the Upper Pliocene and the First phase see P. Pallary (1901), pp. 202-203.

was more wet and perhaps slightly warmer than to-day[1]. It was preceded by a cold phase in the Upper Pleistocene. The latter part of this phase (*i. e.* the Upper Palaeolithic or Capsian) was marked by increasing aridity, while its earlier part (*i. e.* roughly the Mousterian, though perhaps starting slightly earlier) was much more wet. Whether this phase was preceded by a dry interval is not clear from the fauna, though this is very probable on the evidence of certain formations (in W. Morocco). Before that there was a very long and wet phase. At a fairly advanced moment within this phase condition became very warm and evaporation strong, though rainfall may have continued to be fairly high. The earlier part of this phase was on the other hand, slightly cooler, and it followed immediately on the Upper Pliocene which was first marked by a definite phenomenon of "*refroidissement*" (see also Tables VII and IX below)[2].

The Interior Sahara. Evidences of Past Climates.

The climatic changes in the interior of the W. Sahara may be treated with those of N. W. Africa. Here again we find very definite traces of pluviation in recent geological times, but it is not possible to work out the details of the climatic oscillations. At one time this desert region formed an important

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[1] Owing to the frequence of Neolithic remains in cave sites, however, L. Joleaud suggests the possibility of a slightly cooler climate (see reference to his view in A. S. Romer 1928, p. 132). This argument is difficult to accept as the dwelling in rock shelters and caves is affected by many other factors such as wind system, storminess, self-protection, etc. At any rate the evidence of fauna does not seem to be in favour of the suggestion of cool conditions.

[2] Conclusions more or less similar to these have been arrived at by J. Bourcart (1933, p. 826 and 1937, pp. 437-439), from a comparative study of some of the recent formations, animal remains, and, to a less extent, prehistoric evidence in W. Morocco. There he distinguishes the following succession (starting with the oldest) : (1) pluvial climate (Pre-Chellean-Chellean); (2) desert climate with concretions (Acheulean?); (3) wet climate, with red "*limons*" (Monsterian?); (4) a later wet phase with "tirs" soil (Neolithic); and (5) the present dry climate. He regards phase No. 3 as having "Sudanese climate". For this he relies on the existence of some Sudanese fauna in the Mousterian phase; but as we have already seen, there was also a large introduction of Eurasiatic types at the same time (*vide supra* p. 65). In fact there is better reason to think that at least part of this phase was characterised by slightly cooler conditions than to-day (also *vide supra* pp. 68-69).

link between the Sudan Belt and the Mediterranean. Between the Niger river system and the Atlas Mts. there are extensive wadis running chiefly in N.—S. directions[1]. From the Adrar Massif, in the S. Sahara, the Tilemsi and other fossil streams flowed southwards and may have formed the original upper course of the Niger[2]. From the Hoggar (al-Haggar or Ahoggar) Mts., in the C. Sahara, several old channels diverged in nearly all directions particularly the N. N. E. and the S. W. The huge wadis of the Igharghar and the Tafassasset carried the waters of this massif to the Biskra Basin (in the N.) on the one hand, and the interior plains of the confines of Guinea on the other. The S. slopes of the Atlas Mts. were also cut by a net of rivers to the S. and S. E. Evidence from the distribution of mammalian and water fauna, to which reference will shortly be made, shows beyond doubt that during one or presumably more phases of the Quaternary these rivers formed a link of water-ways between Sub-Equatorial Africa and the Mediterranean. The natural topography of this intermediate region, however, had a marked effect upon the development of its former drainage-system. Except in their uppermost parts, the rivers of the vast plateau of the W. Sahara never had a steep profile and they almost invariably ended in closed basins. Even the powerful Igharghar was never able to work its way to the Mediterranean, as topographical surveys have shown that a ridge separates the Biskra Basin (in which it flows) from the sea[3]. The fact that running water was not the only or even the most important agency in modelling the land-surfaces of the Sahara has made it doubly difficult to work out the morphological cycles of Quaternary physiography. It may be argued, on the other hand that, as the rivers were in no way affected by changes in the sea-level, it would be safer to regard their formations (terraces, deltas or *zones d'épandage* etc.) as being directly linked to climatic changes. Unfortunately, however, no expert morphological study of the fossil hydrography of the W. Sahara is available as yet, and palaeoclimatologists

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[1] On this fossil hydrography of the Sahara see E. F. Gautier (1922), pp. 66-68 and (1923), pp. 48-52. Also reference to it in E. Antevs (1928), p. 35.

[2] The capture by the L. Niger of its present Up. course is a recent physiographic event. See R. Chudeau (1925), p. 63 and A.A. Sanfourche (1930), pp. 385-386.

[3] See E. F. Gautier (1922), p. 67 and (1923), pp. 51-52.

have to rely almost entirely on the evidence of the fauna and flora, and, to a less extent, on prehistoric remains.

We have already seen that during the Quaternary there has been a great influx of African mammalian fauna into N. Africa. This could not have taken place if there had not been adequate highways of vegetation and occasionally running-streams across the Sahara. Although hardly anything is known about Pleistocene and Recent palaeontology of the Sahara, there can be little doubt that migration actually took place across its W. and W. C. parts and not over the Libyan Desert or even the Nile Valley. We shall see a little later that the Libyan Desert could not have been so well watered as the Central Massifs or the W. Plateau of the Sahara, and that it never possessed any such large river-systems as might be necessary for the large-scale migrations of fauna over long distances. Furthermore, the mammalian remains from the Nile Valley are very scarce and can in no way be compared with the varied fauna of N. W. Africa [1]. Even if we suppose that the mammals of Inter-Tropical Africa reached the Mediterranean along this valley, it would have been very difficult for all this fauna ultimately to have found its way to the N. W. corner of the continent. This applies more particularly to the aquatic vertebrates and mollusca which would have required a semi-connected series of E. — W. streams across N. Libya. In fact it is chiefly on the evidence of this aquatic fauna that we are forced to the conclusion that the link between the Sudan and N. West Africa is to be looked for along the fossil waterways of the W. and C. Sahara [2]. Sub-Equatorial fishes and water-mollusca are now to be found at favourable spots all over this part of the great African desert as far

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[1] The remains of fauna from the Nile Valley will be mentioned when we deal with Egypt later on. See reference to this fauna in L. Joleaud (1933 *c*), pp. 602-606. If the Nile were the link between the Sudan Belt and N. W. Africa, one would have expected to find along it a richer fossil fauna than in Little Africa; which is of course not the case (at least up to now). It should be made clear, however, that the scarcity of the fauna of the Nile Valley may be partly due to the fact that the Quaternary terraces of that river are coated with hard concretions in which the bones have been very much broken or in some cases dissolved.

[2] We must of course suppose that there existed local "captures" across the water-sheds between the Saharan streams flowing southwards and those flowing northwards. This is necessary to account for the spreading of the water-fauna from the Sudan to N.W. Africa. The synchronism of pluviation N. and S. of the Sahara will be discussed more fully at end of present Part.

as the Atlas [1]. Several fish species, like *Clemmys leprosa* Schw., *Labeo horie* Heckel, *Barbus deserti* Pellegrin, *B. anema* Boulenger, *Clarias lazera* C. V., *Hemicromis bimaculatus* Gill, *Tilapia Zilli* Gervais, *T. borkuana* sp. etc., have been collected from this region. To these may be added warm (Sub-Equatorial?) molluscs such as *Limnæa, Physa, Planorbis* sps. etc. Some of the fishes have a wide distribution and are found in the river-systems of W. Africa, the Nile and even as far as Palestine. But the fact that such large types as *Crocodilus niloticus* Laur. still survive in some places such as the Tassili Massif of W. C. Sahara [2], indicates that the date of the cessation of the spreading of these forms northwards must be very recent [3]. This northward spreading of the water-fauna was counterbalanced by a southward spreading from the Mediterranean into the Algerian Sahara and the Massifs of the W. C. Sahara. There we find a mixed fauna of fishes including *Cyprinodon, Barbus biscarensis* Boulenger etc. of the palaearctic group of the Mediterranean [4]. Also a few of the Northern mollusca (such as *Melanopsis marocana* among aquatic forms and *Helix* and *Rumina* among land ones) appear to have penetrated southwards into Touat and the Hoggar [5]. It is interesting to note, however, that the mixture of the N. and S. water fauna in the Northern Sahara occurs only W. of the Central Massifs and not E. of them. As Pellegrin points out, all the water-fauna of the "*Sahara oriental*" is of an Ethiopian origin and has nothing to do with Mediterranean [6]. This is interesting because it shows that it was

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[1] On the fishes see J. Pellegrin (1911), pp. 297-299 (1911 *a*), pp. 972-974 (1913), pp. 346-353 (1919), pp. 961-963 and (1919 *a*), pp. 263-265; also references in G. Cauvet (1915), p. 102 and E. F. Gautier (1922), p. 66. On the Mollusca see R. Chudeau (1925), p. 63,

[2] See J. Pellegrin (1911 *a*), p. 972; also E. F. Gautier (1922), p. 66.

[3] The surviving specimens, though in some cases representing degenerate (residual) fauna, have had no time to differentiate themselves. In some dry places, where only bones are found, these latter are frequently only in sub-fossil state. See e.g. reference to the Borku region (S. Sahara) in J. Pellegrin (1920), pp. 207-208. It should be noted, however, that the degree of fossilisation cannot always be relied upon as a criterion of the age of the bones, especially in a desert climate.

[4] J. Pellegrin (1919), p. 962,

[5] R. Chudeau (1925), p. 65. *Cardium edule,* the salt or brackish water specimen has also been found in formations as for south as Touat [See R. Chudeau (1925), p. 63].

[6] J. Pellegrin (1919), p. 962. As we shall see later on, however, land-shells from the Mediterranean were mixed with C. African types in the region of Khargah (Libyan Desert of Egypt).

due to the existence of the Atlas Mts. and their southward flowing streams that the Mediterranean fresh water fauna was able to penetrate into the N. W. Sahara. The streams flowing eastwards from the Central Massifs were not very important and in many cases they did not even reach the Mediterranean coastal region proper.

The flora of the interior of the Sahara also offers some interesting points. *Cocculus leoeba,* whose fruit could not be transported by wind, is to be found nearly all over the Sahara (*i. e.* wherever there is a sufficient supply of water)[1]. As in the case of the fauna, there seems to have been a spreading of Sudanese and Mediterranean plants in both directions. With the present desiccation, the C. Massifs and the scattered oases have become the last resorts for the penetrating flora. In this respect the Hoggar (or Haggar) Massif deserves special mention as it illustrates the mixture of the two types of immigrant flora[2]. It has a few Sub-Equatorial or Equatorial specimens (*Typha elephantina, Erigeron Bovei*), a large number of Sudano-Ethiopian ones (*Balanites, Maerua, Calotropis, Tephorsia, Solenostemma, Leptadenia, Salvadora, Aerva, Abutilon, Trichodesma,* etc.) and a number of Algerian and Mediterranean types (*Artemia, Santolina, Clematis flammula,* etc.). According to R. Maire[3] the slopes of this Massif may be divided into three zones : 1) The so-called Sub-Equatorial : up to 1700-1800 metres, with no permanent vegetation except in the bottom of the valleys and in watered deltas. The flora is chiefly Sudano-Ethiopian, with some Sub-Equatorial types. There are also some Saharan species with Mediterranean affinities. 2) The lower Mediterranean zone : between 1700-1800 metres and 2300-2400 metres, with only a few Sudano-Ethiopian types and an increasing number of species from the Mediterranean or having Mediterranean affinities. 3) The high Mediterranean zone : from 2300-2400 metres up to the summits (3000 metres), with no Sudano-Ethiopian types, and having a number of typically Mediterranean plants. This zone also has a permanent vegetation

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[1] R. Chudeau (1925), p. 65.

[2] See Ed. Bonnet (1912), pp. 513-516; also more recent work by R. Maire (1928), pp. 1680-1682.

[3] R. Maire (1928), pp. 1180-1181.

of steppe (outside the watered areas) similar to that on some of the Algerian plateaux.

All this evidence, however, does not go far beyond indicating that the interior of the Sahara had a higher precipitation at some recent geological period. We have so far no precise data as to the details of that period of rainfall. Even archaeological finds, which may be of some indirect help, have been found only on the surface and can therefore be only of limited value. We know, however, that as in N. W. Africa, the Neolithic phase appears to have been less arid than to-day. Not only are there numerous Neolithic settlements in places now entirely dried up[1], but there is also a fairly marked contrast between the distribution of the finds relating to the Early Neolithic phase and those relating to the historic cultures. Whereas the Early Neolithic settlements are generally found in the bottom of the valleys and in deltaic regions (formerly well watered), the remains of the historic cultures occur only on the tops of the highlands to which the people appear to have been forced to "go up"[2]. Before the Neolithic, however, conditions seem to have been again dry. We shall see in Section ii of Part II of the present work that the Upper Palaeolithic cultures (chiefly Capsian, and Later Atirian) were limited to Little Africa, parts of Mauretania, the Senegal coast and parts of the Sudanese Sahara (*vide* also our Map 3 on Pl. III). This distribution is significant as it indicates that the heart of the Sahara was drying up towards the close of the Pleistocene. Before this phase of progressive aridity very little is known beyond that the Quaternary climate of the Sahara was on the whole more genial than to day[3]. One interesting piece of

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[1] See S. Gsell (1921), pp. 55; R. Chudeau (1925), p. 65 and C.E.P. Brooks (1932), p. 65.

[2] For this interesting remark see E. F. Gautier (1908), pp. 134-135; also Th. Monod (1931), pp. 265-266. We shall see in Section i of the following Part that the distribution of Chelleo-Acheulean cultures in this part of the C. Sahara is very similar to that of the Neolithic, *i. e.* almost exclusively in the lower valleys and in deltaic regions and not on the highlands. It would be interesting to try to account for this peculiar distribution, which may mean that even in the L. Palaeolithic rainfall was just plentiful enough to keep a luxuriant vegetation in the valleys and deltas, which have consequently become the best hunting-grounds. However, this point must be left for further discussion in the appropriate place.

[3] This may be attested by the existence of Middle and more particularly of Lower Palaeolithic implements in various parts of the Sahara.

evidence, however, comes from the study of the fossil sand dunes especially on the South side of the Sahara [1]. On the coasts of S. Mauretania (Senegal) there are old dunes, now almost wholly fixed by an overgrowth of vegetation, which extend well into the zone receiving a fair amount of the summer rains of the Southerly Monsoons. It appears that they were formed during a phase of weakness of these latter winds, coupled by a relative strength of the dry N. Easterly Harmattan [2]. The age of these dunes could not be fixed with certainty [3], but in any case they are the only evidence we have at present of a dry phase within the Pleistocene [4].

And now to summarise the climatic changes as they may be deduced from the available data we may note that the present dryness dates roughly from Post-Neolithic times [5]. The Early Neolithic phase itself was probably more wet (though perhaps also slightly warmer?) than to-day, but it was preceded in turn, by a phase of progressive aridity in the Upper and Final Palaeolithic. The rest of the Quaternary had a pluvial climate, but there are indications that during a certain interval (probably at an advanced phase of that period [6]) the climate was drier than at the present day. This is the only case of a real "Interpluvial" in the Quaternary of the Sahara.

[1] On these dunes of the S. Sahara generally see R. Chudeau (1925), p. 63.

[2] See L. Aufrère (1930), p. 224. The direction of these fossil dunes is N.E.- S.W. (or W. S. W.), which shows that although at that time the dry Harmattan gained in strength at the expense of the Monsoons, their general direction remained unchanged.

[3] It is difficult, however, to attribute them to the phase of increasing desiccation during the Up. Palaeolithic, as implements of this cultural phase are found in Mauretania and Senegal (*vide supra* p. 75). This would rather indicate that conditions were probably not much drier than to-day.

[4] It should be pointed out, however, that although it is clear in this case that the dunes were the work of an exceptionally strong and dry Harmattan, sand-formations cannot be always taken as an indication of aridity. In some places in the Sahara, the growth of *ergs* was closely connected with the activity of former rivers which brought down large quantities of loose material. This material may have been blown by wind (thus forming *ergs*, dunes or "seas" of sands) during the dry seasons. On the climatic classification of dunes in general see L. Aufrère (1933), pp. 700 and 703-704.

[5] Although of course some of the "retarded" so-called "Neolithic" settlements may have dated from historic times (*vide supra* footnote 2 on p. 63).

[6] Although the interior of the Sahara is not yet fully explored, one might say that the remains of the early Middle Palaeolithic are more rare than those of either the Late Mousterian or the L. Palaeolithic. This might throw light on the date of the dry interval. It seems almost certain that this Interpluvial was pre-Mousterian.

Correlation between Little Africa and Interior Sahara.

The evidences outlined above tend to show that the climatic changes in the interior of the Sahara were closely parallel to those of N. W. Africa. This will be dealt with in more detail in wider correlations with other parts of the Saharo-Arabian Belt and also with Equatorial latitudes later on. Table VII, below, gives a simplified correlation on a local scale between the C. and W. Sahara and Little Africa, in so far as could be worked out in the present state of our knowledge.

TABLE VII.

A tentative reconstruction and correlation of climatic changes in Quaternary and Recent times over N. W. Africa and the interior of the W. and C. Sahara (as may be drawn from works mentioned in footnotes on pp. 63-76). For purposes of clarity this Table has been much simplified. For further details see Table IX. The Table reads upwards, and no time-scale is attempted.

PHASES.	N. W. AFRICA.	INTERIOR SAHARA (W. AND C.).
Post-Neolithic	Dry.	Very dry.
Early Neolithic ...	Rather wet and warm. Appearance of *EL. africanus* etc. Also rich water fauna.	Rather wet (and perhaps warm?). Migration of mammals and fishes across Sahara.
2nd. Pluvial	Increasing dryness in Up. Palaeol. Still rather cool (?).	Increasing dryness at close of Pleistocene, particularly in Innermost Sahara.
	Wet and somewhat cool climate especially in Mousterian. Mixed fauna.	Presumably wet and temp. climate. Migrations of fauna and flora.
Interpluvial	Apparently very dry (desert) climate. Extensive concretions (*croutes*) in W. Morocco. Extensive land-movements, and lava-flows.	Desert climate with sand formations especially on the fringes of the Sahara.
1st. Pluvial	Very long wet phase, with Sub-Equatorial fauna. Presumably divisible into three sub-phases (?). *C.* Wet and temp.	A suggested long wet phase (migrations of fauna and flora), apparently with a hot sub-phase in the middle (Chellean?) (the rise of temperature rendering the rainfall less effective).
	B. Wet but very warm. Intensive evaporation and formation of travertines. (Chellean?).	
	A. Wet and rather cool or cool temp.	
Early Up. Pliocene.	A phase of *refroidissement.*	?

Tripolitania. Indications of Climatic Changes.

We must now leave the W. and C. Sahara and proceed to the N. E. corner of the continent. A few words, however, should be said about Tripolitania. Unfortunately this intermediate region is hardly even explored as yet and nothing is known about its climatic changes in recent geological times. Nevertheless, it appears certain that even during pluvial phases its total rainfall was well below that of N. W. Africa. Only the high plateau of Barqah (Cyrenaïca) and its surrounding plains may have received a fairly abundant rainfall. The W. and C. parts of Tripolitania are largely covered with "seas" of sands, while its N. E. corner consists of a vast *Serir* or gravel spread [1]. According to A. Desio this latter was in all probability formed during a phase of pluviation [2]. The extent of this pluviation inland is difficult to assess, though the fact that the dry Wadis to the South of Lat. 30° are generally much obliterated by sands [3] may perhaps show that the pluviation there came to an end at an earlier date than in the North (where Wadis are better preserved) [4]. As to the possible number of pluvial phases, nothing can be said with certainty. We shall see at the end of the archaeological Part of the present work, however, that in "Neolithic", or rather "Post-Neolithic" times (before the rise of Egyptian dynasties) Egypt appears to have had fairly strong contacts with the cultural groups of N. W. Africa. It is of course rather difficult to think of any other route of such contact than that of N. Tripoli. This, together with archaeological finds from the N. parts of the Egyptian desert may serve as an indirect indication that at that time the coasts of Libya and Tripolitania received slightly more rain than to-day. In the Quaternary proper we have evidences from Barqah of two physiographic cycles, associated with

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[1] On this see A. Desio (1933 *a*), p. 11.

[2] A. Desio (1931), p. 37.

[3] See A. Desio (1931), p. 37.

[4] It is quite possible, however, that some of these southern Wadis are very old (Tertiary), and that they ended in a sea whose coast lay more to the South than to-day. On the other hand, it may be argued that the greater obliteration (by the sand) of the S. Wadis does not necessarily indicate that the difference in date between the beginning of the desiccation here and in the N. was very great, as the work of the present æolian erosion gets stronger as we penetrate southwards.

changes in the coast-level, but which may also be related, in part, to climatic changes[1]. In the Wadi Derna (near Bu-Mansour) there is a terrace system which appears to be divisible into two main terraces. One of these rises only a few metres above the bed, while the other (which is very much worn), reaches as high as 30 m.[2]. It is difficult to date these two terrace-levels, but implements described as "Palaeolithic"[3] have been found on the surface of the lower one, while the state of preservation of the higher one betrays its old age. On the coast there is a raised beach at 85-100 m. and a sea-cut cliff (*gradino*) rising some 30-50 m. above it and merging into the Upper coastal plain at 150 m.[4] According to Italian workers the two cycles of erosion (mentioned above) were separated from one another by an elevation of the coastal region which led to the emergence of the 100 m. beach[5]. Of course the initiation of the second cycle may have been almost entirely due to the elevation of the land (in relation to sea-level), but it is also probable that it corresponded to a separate (and more recent) pluvial phase from that of the earlier cycle[6]. If this be so, it would appear that there were two main pluvial phases in the Quaternary, separated by an interval during which there were land-movements and elevation. This would agree, on general lines, with what we have seen in N. W. Africa and the interior of the Sahara.

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[1] On these cycles see G. Stefanini (1930*a*), pp. 23-25 and 38-39, and A. Desio (1928), pp. 21-23 and 39.

[2] G. Stefanini (1930*a*), p. 25.

[3] Of course these finds give an uppermost dating limit to the terrace. Unfortunately we were not able to trace the cultural phase or technique of these "palaeoliths". We believe from available accounts of finds from N. Tripolitania, however, that these implements belong either to the Atirian or to some Up. Palaeolithic blade-culture.

[4] See A. Desio (1928), p. 21. On higher and older coast-lines (at 250-300 m. and 600 m.) in Barqah see G. Stefanini (1930), p. 60. In other places on the coast of Tripolitania proper there are beach-levels at 8-15 m. and 30 m. See G. Stefanini (1930), p. 160 and (1930*a*), p. 24. Owing to well ascertained differential movements in this region, however, the actual elevation of these coast-lines could not give any reliable indication as to their age. On the irregular changes of the coast-line see A. Desio (1933), p. 10.

[5] See A. Desio (1928), p. 23.

[6] In a region like Barqah (Cyrenaïca) which is essentially a "table-land" the changes in the coast-level would have a less marked effect upon physiographic cycles than they would usually in regions with a wider and gradually sloping coastal margin.

EGYPT AND ITS LIBYAN DESERT.

EVIDENCES OF QUATERNARY AND RECENT CLIMATES.

Fossil Fauna.

In Egypt and the L. Nile Valley the question of climatic changes attracted the attention of geologists, physiographers and prehistorians at an early stage. As early as the eighties of last century the case for a Pluvial Period was put forward by various workers[1]. As we have seen, however, the existence of such a period of excessive rainfall in recent geological times has not been accepted by all (*vide supra*, pp. 60-62). Unfortunately the evidence for climatic changes in this region has to be drawn almost entirely from physiographic data, as the finds of mammalian and other animal remains are very scanty[2]. Here and there a few bones have been found in Egypt, either *in situ* or in historic cemeteries where they had been deposited[3]. At Kom Ombo animal remains have been found in association with Upper Palaeolithic (Sabilian) formations. They include the hippopotamus, the lion, the great buffalo, a small equid, small rodents, fishes, etc.[4]. In cemeteries near Assiut, depots of fossil-bones (presumably collected from some Pleistocene beds—perhaps equivalent of the Up. Palaeolithic) have yielded[5]:—*Hippopotamus* (*Hexaprotodon*) cf. *sivalensis* (very abundant)[6], *Equus sivalensis*, *Crocodilus* (cf. *indicus*), *Sus* cf. *hysudricus*, *Camelus* sp., *Cervus* sp., *Bos* (*Bibos*) cf. *sivalensis*, *Emys* cf. *sivalensis* etc. In the Fayyoum a fauna which is almost certainly Neolithic included *Elephas*

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[1] See e. g. Ed. Hull (1885), pp. 181-182.

[2] We have already mentioned one of the probable reasons for this scarcity *vide supra*, footnote 1 on p. 72.

[3] L. Joleaud (1933*c*, note 1 on p. 602) believes they were collected by fossil ivory hunters. It is not clear whether these bone-depots had some sepulchral significance.

[4] This fauna has never been sufficiently worked out. See reference to it in Ed. Vignard (1928), pp. 203, 207 and 216; also L. Joleaud (1933*c*), p. 603, and recent identifications by K. S. Sandford (1934), p. 86.

[5] See L. Joleaud (1933*c*), p. 602-603; also K. S. Sandford (1929*b*), pp. 536-541.

[6] 90 % of the bones found at Qau belonged to Hippopotamus.

africanus, Hippopotamus amphibius, Bubalus lelwel, Oryctolagus cuniculus, etc.[1]. The fragmentary nature of this faunistic data[2], however, is quite clear, and it makes it practically impossible to draw any fruitful comparisons with such neighbouring regions as Palestine (from which a fair amount of bone-remains has been forthcoming). Furthermore, the existence of such a large river as the Nile has been a helping factor not only in the survival of many types which might have otherwise become extinct (during dry phases), but also in the flourishing (beyond all proportions) of certain types as the hippopotamus. Thus the Nile has minimized the effect of climatic changes upon the fauna which could therefore be of very limited value to the palaeoclimatologist.

Physiographic Evidence. The Fayyoum Depression.

The physiographic evidence from N. E. Africa, however, is fairly extensive and may partly compensate for the inadequacy of the palaeontological data. From a comparative study of recent formations in the Nile Valley and Palestine, M. Blanckenhorn was able to reconstruct the climatic changes of the Quaternary and even to equate them with the changes in Europe (Alps)[3]. His conclusions, however, were largely based on his Palestinian work, and appear to have been affected—in a conspicuous measure—by a pre-existing belief in the correlation of glacial and pluvial episodes. It may therefore be advisable to defer the examination of his arguments till a little later. In the meantime we propose to review the evidences brought out by more recent workers (mainly Gardner and Caton-Thompson on the one hand and Sandford and Arkell on the other) in the Nile Valley and some of the adjacent depressions of the Libyan Desert.

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[1] See C. W. Andrews (1903), p. 339; also L. Joleaud (1933*c*), p. 606; and G. Caton-Thompson (1934*b*), pp. 72, 84 and 89.

[2] Isolated vertebrate remains have been discovered by Bovier-Lapierre in the gravel pits of 'Abbasiyyah plain (Cairo). They still await publication. See reference in K. S. Sandford and W. G. Arkell (1939), p. 52.

[3] See his works (1910), pp. 425-428; (1910*a*), pp. 405-461; (1914), p. 36-41 and Table on pp. 52-53; (1921), pp. 151-172; and (1921*a*), pp. 5-12.

Beginning as usual with proto-historic times, the Fayyoum Depression affords interesting data. High beaches mark ancient levels of the lake occupying the bottom of the Depression (whose lowest point lies at 53 metres below sea-level)[1]. Diagrams 1, 2 and 3 (on our Plate IV) give a summary of the views of E. W. Gardner and G. Caton-Thompson (Diags. 1 and 2) and K. S. Sandford and W. J. Arkell (Diag. 3) about the physiographic history of the Depression in Quaternary[2]. According to the former two workers the cutting of the free hydrographic relations between the Nile and the Lake (probably due to a silting up of the Hawwarah Channel) took place just before the establishment of the Neolithic culture in the Depression (*i. e. circa* 5500 B. C.)[3]. Between the dates which may be roughly fixed as the middle of the 6th mill. B. C. and the middle of the 3rd mill. B. C. the lake depended for the maintenance of its level on local rainfall[4]. The fact that at least on two occasions it was able to maintain a stationary level (at -2 metres below sea-level and, before that, at 10 metres above sea-level) for a fairly long span of time indicates that the rainfall was more or less equal to evaporation (*i. e.* higher than the present day). The falling from one level to the other (with an intermediate beach at 4 metres above sea-level) is dated a little after 5000 B. C. Immediately before the «Neolithic» phase the lake stood at 18 metres above sea-level[5]. The rise of the lake to this level,

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[1] The surface of water in the Lake Qarûn, which now covers the bottom of the Depression and is used for drainage purposes, is at present controlled at a mean level of *circa* 45.4 m. below sea-level. See J. Ball (1939), pp. 237-38.

[2] For a summary of earlier investigations in the Depression see G. Caton-Thompson and E. W. Gardner (1929), pp. 21-26 and J. Ball (1939) pp. 178-184. Another recent worker, G. Hug (1927, pp. 1-50), has also carried out a general survey of the Depression; but his conclusions are based on so few physiographic data that they can be only incidentally referred to here.

[3] For the physiographic history of the Depression according to these two workers see: E. W. Gardner (1926*a*), pp. 306-307 (1927), pp. 388-406 (1934*b*), pp. 12-18; and G. Caton-Thompson and E. W. Gardner (1929), pp. 32-36 (physiographic evidence) and 36-42 (archaeological evidence). See also G. Caton-Thompson, E. W. Gardner and S. A. Huzayyin (1936-1937), pp. 244-253 and 287-290.

[4] On the stages of this so-called "Neolithic Lake" see G. Caton-Thompson and E. W. Gardner (1929), pp. 34-36 and 39.

[5] On this level see E. W. Gardner (1926*a*), p. 306 and G. Caton-Thompson and E. W. Gardner (1929), pp. 39-40 and 42.

however, was due to the breaking-in of the Nile and not necessarily to any increase in local precipitation [1]. This is shown by the fact that immediately the Nile ceased flowing freely into the Fayyoum, the Lake fell steadily to the 10 metres level. The breaking-in of the Nile and the formation of the 18 metres lake was apparently due to the aggradation by the river of its bed towards the end of Final Palaeolithic times (or slightly later?). Prior to that there was a phase of dryness (and arid local erosion) in the Fayyoum [2]. The lake was not connected with the Nile and it may have dried up. At an earlier stage still there was another phase of communication between the Nile and the lake (the water flowing in the direction of the latter). This latter phase was characterized by more than two distinct lake-levels (at 22-23 metres and 35 metres, with a storm-beach at 40 metres) [3]. Implements belonging to a so-called "Mousterian" (better to be termed as "Levalloisian" and "Diminutive Levalloisian" industry) were found in some of the deposits of these lakes and in profusion on the surface of others [4]. Whether these levels corresponded to any climatic changes is not at all certain, as the falling lake was entirely controlled by the Nile which appeared to be degrading its bed by stages. All that is known with certainty, according to these two writers

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[1] See G. Caton-Thompson and E. W. Gardner (1929), p. 53. Faunal evidence (mollusca) is also in favour of an influx of Nile waters; see G. Caton-Thompson and E. W. Gardner (1929), p. 39. See also E. W. Gardner's work (1932 *b*).

[2] See E. W. Gardner (1929 *a*), pp. 378 and 382. The Nile was degrading its bed before it started the aggradation process mentioned above. See G. Caton-Thompson and E. W. Gardner (1929), p. 52. Also on these phenomena of degradation and aggradation in the L. Nile valley see K. S. Sandford and W. G. Arkell (1939), fig. 22 on p. 76.

[3] See G. Caton-Thompson and E. W. Gardner (1929), pp. 32-33, 37-39 and 41-42; also E. W. Gardner (1926 *a*), p. 306 and (1929 *a*), p. 377. Two other beaches (at 28 metres and 23-24 metres) have also been recorded; see reference in G. Caton-Thompson, E. W. Gardner and S. A. Huzayyin (1936-1937), p. 245.

[4] Apparently this Middle (and Up.) Palaeolithic industry was somewhat later than the 40 m. maximum. It was found *in situ* in the 35 m., 28 m. and 23-24 m. (and 22 m.) beaches; see reference in K. S. Sandford and W. G. Arkell (1929 *d*), pp. 41 et seq.; G. Caton-Thompson, E. W. Gardner and S. A. Huzayyin (1936-1937), p. 245 and S. A. Huzayyin (1939), p. 208, footnote 2. Surface implements were found as low as -6 m. below sea-level. See G. Caton-Thompson and E. W. Gardner (1929), pp. 38-52; also G. Caton-Thompson (1926 *a*), pp. 313-314 and (1929 *a*), p. 132, and E. W. Gardner (1929 *a*), p. 382.

(Caton-Thompson and Gardner), is that prior to this Middle Palaeolithic phase of influx from the Nile, there was a phase of desiccation in the Fayyoum. Not only did the Nile not flow into the Depression, but the formations of the latter show little or no traces of torrential run-off [1]. The establishment of desert or semi-desert conditions, however, appears to have been preceded by a phase of moderate rainfall [2]. The Depression may have been occupied by a lake or an internal sea of which we do not know the exact dimensions.

From this account, it is clear that the evidence as worked out by Gardner and Caton-Thompson brings out the following succession (beginning with the most recent) [3] : 1) a wet phase in Neolithic times (perhaps with two sub-phases?); 2) a dry interval in Final and late-Upper Palaeolithic times : 3) an earlier Middle Palaeolithic phase of unknown climate (but presumably wet?); 4) a desert or semi-desert phase prior to that; and 5) an earlier phase of better climate, which presumably coïncided with a lake or an inland sea in the Fayyoum. Following H. J. Beadnell, these two authors regard the Depression as having already existed (though perhaps not quite in its present form and depth?) at the beginning of the Pleistocene [4].

The physiographic story of the Fayyoum as worked out by K. S. Sandford and W. J. Arkell is somewhat different from the one we have just reviewed [5]. As we see from Diag. 3 (our Pl. IV) the excavation of the Basin is attributed to hydrographic agencies working entirely within the Pleistocene. These authors do not find any evidence of climatic oscillations; and they believe in the

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[1] See E. W. Gardner (1929 *a*), p. 376.

[2] See E. W. Gardner (1929 *a*), p. 375.

[3] We need not enter here into the controversy of whether there existed a high-level lake in the Fayyoum in historic times (the so-called Lake Moeris). "Indisputable proofs of the existence of such a lake may still be forthcoming, but we do not think that they have yet been presented"; see G. Caton-Thompson, E. W. Gardner and S. A. Huzayyin, 1936-1937, p. 290. Also *vide infra*, footnote 2 on p. 86.

[4] See E. W. Gardner (1929 *a*), pp. 371-375. For H. J. L. Beadnell's opinion on the pre-Pleistocene excavation of the Fayyoum Basin, as well as of other desert depressions by ordinary sub-aerial erosion (wind, storms, etc.) operating in areas with particularly weak structure, see his works (1901), pp. 93-95 and (1905), 71-81 and 25-26.

[5] See K. S. Sandford and W. J. Arkell (1928 *c*), pp. 670-671, (1929), pp. 67-69 (1929 *c*), pp. 578-582 and (1929 *d*), p. 3.

existence of one uninterrupted Pluvial Period which continued right down to Upper Palaeolithic times[1]. The lake-levels which they traced in the Fayyoum coïncided roughly with those of Gardner and Caton-Thompson, and we need not describe them in detail. Suffice it to mention the following phases in their scheme (beginning with the most recent) : 1) In "Neolithic" times four levels at -2 metres, 4 metres, 10 metres and 18 metres above sea-level were found[2]. These falling levels were controlled by the Nile which drainedinto the Fayyoum[3]; 2) The "Neolithic" lakes were preceded by a phase during which the drainage through the Hawwarah Channel was from the Fayyoum into the Nile[4]. During this phase which they date as the "Final Capsian", the Basin is believed to have been deepened by some 50 metres to its present level[5]; 3) During the Upper Palaeolithic

[1] See K. S. Sandford (1929*b*), p. 543.

[2] We may further note that Sandford and Arkell attribute the 18 m. lake to the in-flow of waters from the Nile, a river which was aggrading its bed at that time. They date the lake as "Neolithic" (see their work 1929*c*, pp. 580-581). The Neolithic folk, however, do not seem to have established themselves in the region until after the lake had begun to fall. At any rate, this level can best be dated as immediately prior to the Neolithic of the Fayyoum. Hug (1927, pp. 45-50) regards this 18 m. level as historic, but gives no evidence in support of his assumption. Also the Geological Survey of Egypt (G. H. Little, 1935-1936, pp. 209 et seq. and diagramatic cross-section) has more recently suggested two historic (XIIth Dynasty and later) levels at 17-22 m. (the earlier one) and 22-24 m. Evidence presented by the Survey, however, has given rise to various strong objections; see G. Caton-Thompson, E. W. Gardner and S. A. Huzayyin (1936-1937), pp. 253 et seq. Also *vide supra* footnote 3 on p. 85.

[3] On this point the authors differ from Caton-Thompson and Gardner; compare Diags. 1 and 3 on our Pl. IV. It should be made clear, however, that the "Neolithic" phase of the relation between the Nile and the Lake is not sufficiently cleared up as yet. While it is evident that the *falling* "Neolithic" lake could not have been freely controlled by the Nile, we cannot easily decide upon the factors which led to the severing of connection between Nile and Lake. Either that the Hawwarah Channel was choked with alluvium, or that the river, after having quickly reached its maximum aggradation in the earliest stages of the Neolithic (or the Proto-Neolithic), has started on a new phase of temporary degradation which made it no longer possible for its waters to pass through the Channel. Also *vide infra,* end of Appendix A to present Part.

[4] See K. S. Sandford and J. W. Arkell (1929), p. 69 and (1929*d*), p. 72.

[5] See K. S. Sandford and W. J. Arkell (1929*c*), p. 581. We may further notice here that serious objections may be raised against the theory of Sandford and Arkell as to the excavation of the Fayyoum Depression by water erosion in the direction of the Nile Valley. The Hawwarah Channel constitutes the only suitable outlet (from the Fayyoum Depression) through which such an

and the so-called "Mousterian" (better to be termed as Levalloisian and Diminutive Levalloisian) stages there was another phase of drainage from the Nile into the Fayyoum, and three lakes were formed at 22 metres, 28 metres, and 35 metres (earliest) above sea-level[1]; 4) Prior to that there was a very long phase of drainage into the Nile[2]. During the latter part of this phase the Nile Valley was very low and the Basin was excavated, presumably to sea-level. In its earlier part, on the other hand, the Nile was high and the Fayyoum is thought to have stood more or less at the same level as the surrounding plateau.

From this summary it may be noted that the main point on which Sandford and Arkell differ from Gardner and Caton-Thompson (with Beadnell) is that they (the former) believe that the Depression did not exist before the Pleistocene, and that it was carved out by stream activity during two phases of drainage towards the Nile. Several physiographic difficulties, however, could be raised against this view[3]. Suffice it, perhaps, to mention the fundamental point that the suggested two phases of erosion (the one "before the Mousterian" and the "Final Capsian" one), would have been somewhat too short for the excavation of such a vast and deep depression to have taken place. While the shortness of theses phases, especially the latter one (during which the Fayyoum Depression is said to have been deepened by 50 metres), would imply very strong precipitation and erosion, the Pluvial Period in the Nile Valley is regarded by Sandford and Arkell to have been gradually giving

erosion could have taken place. Ten bores to bedrock have been spaced across the Channel by the Geol. Survey of Egypt, and the deepest point of the Channel was found not to exceed—18 (or 17-18) m. below sea-level (see G. H. Little, 1935-1936, p. 221; also reference in J. Ball, 1939, p. 191). This means that the bottom of the Channel-bed is some 35 m. higher than the deepest parts of the Depression. Reverse drainage from the Fayyoum towards the Nile could not have caused the Fayyoum Depression to be excavated to a lower level than —17 m. (below sea-level).

[1] See K. S. Sandford and W. J. Arkell (1929), pp. 67-68 and (1929*c*), p. 579. The 28 m. level was not at first recognised by E. W. Gardner (see her earlier work 1929*a*, p. 377).

[2] See K. S. Sandford and W. J. Arkell (1929*c*), p. 579.

[3] For a physiographic discussion and criticism of this view, see E. W. Gardner (1929*a*), pp. 374-380 and reply to same by K. S. Sandford and W. J. Arkell (1929*c*), pp. 578-584. Also *vide supra,* footnote 5 on pp. 86-87.

way to desert conditions from early Up. Palaeolithic times onwards [1]. While therefore accepting the possibility of a certain amount of water erosion as an agency in the carving out of the Depression, we find it difficult to agree to the very recent dates suggested by Sandford and Arkell [2].

The L. Valley of the Nile.

In the Nile Valley itself, no definite evidences relating to climatic changes have been forthcoming as yet. Unfortunately the existence of the ever-running river, with its seasonal floods, has rendered almost impossible the preservation, as such, of formations which might indicate dry phases (such as breccia or blown sands) [3]. It is therefore no longer possible to work out any climatic sequence on the evidence of physiographic data from the Valley itself. For this and for other reasons, we propose to reserve for separate discussion (in an Appendix at the end of the present Part) the work of Sandford and Arkell in the Valley. We shall then see that a full elucidation of the recent physiographic history of the L. Nile could be made possible only in the light of climatic oscillations within the Quaternary, as may be worked out in other parts of N. E. Africa.

The Khargah Depression and Scarp.

Recent work by G. Caton-Thompson and E. W. Gardner in the Khargah Depression of the W. Desert has yielded valuable material relating to past

[1] See K. S. Sandford (1929*b*), p. 543.

[2] Also in order that erosion by drainage into the Nile should take place, the level of the latter must have been very low during the two suggested phases of erosion. This was true of the "Final Capsian" phase, though it has not been proved as yet for the phase "before the Mousterian". On this point see Sandford and Arkell (1929*c*), p. 579 and remark by Gardner at end of same article (pp. 583-584); also Sandford and Arkell (1939), pp. 76 and 99. At any rate, however, water erosion could not have been effective except in the early stages of the carving of the Depression, *i. e.* before it was lowered to —17 m. (*vide supra*). It was perhaps wind and sub-aerial denudation assisted at first by slight water erosion and, later on, by subterranean solution and percolation, which acted as the main agents in the carving and deepening of this vast depression.

[3] This interesting remark is made by E. W. Gardner (1932), p. 403, as an explanation of the non-existence of Pleistocene breccia on any large scale in the Nile Valley.

climates [1]. The conclusions drawn from this work are, on the whole, in harmony with those arrived at by the same workers in the Fayyoum. Beginning with the most recent episodes we find that there is abundant evidence from the Plateau that climatic conditions were slightly more favourable in "Neolithic" (*senso lato*) times than they are to-day. The accumulation of water from more frequent rain-storms, in solution-pans (coated with red loams of the insoluble materials in the limestone), made it possible for scanty Neolithic (or later) groups to live on the now entirely dry Plateau [2]. In the Depression itself and on the Scarp bounding it to the East there are clear indications as to pluvial conditions in earlier geological phases. Indeed the existence of Pleistocene tufas with plant remains (first thought to be *Quercus ilex,* but now identified as *Ficus ingens, F. sycomorus* Linn. and *F. silicifolia* Vahl.) were discovered as early as the seventies of last century [3]. Some authors would go as far as to infer from this, and some other indications, that the Depression was excavated by running-water erosion at some very recent geological date [4]. This view, however, has now been definitely discarded [5]. Wind and ordinary sub-aerial erosion (by torrents etc.) were probably the main agents in this excavation. Even at the maximum of the pluvial phases the rainfall was probably never really as high or as regular as that now prevailing in the Mediterranean [6]. It is interesting, however, that owing to this general

[1] On this work see particularly E. W. Gardner (1932), pp. 388-420 and G. Caton-Thompson and E. W. Gardner (1932*a*), pp. 389-397. Also forthcoming publication by both authors probably in the *Mém. de l'Institut d'Égypte.*

[2] See G. Caton-Thompson and E. W. Gardner (1932*a*), pp. 371-372.

[3] For the discovery of the so-called *Q. ilex* (evergreen oak now living in the N. Mediterranean) see K. Zittel (1883), p. CXLI; also reference in J. Ball (1900), pp. 91-92; F. W. Hume (1910), p. 423; G. Anderson (1910*a*), p. LIII; and J. I. Craig and W. F. Hume (1911), p. 383. The new identifications are made as a result of recent discoveries by Caton-Thompson and Gardner (information kindly given by the former). These new identifications are interesting as they show that the total rainfall was still less than would have been necessary for the maintenance of the evergreen oak.

[4] See e. g. L. W. Collet (1926), p. 534.

[5] See J. Ball (1927), pp. 28-32; also G. Caton-Thompson and E. W. Gardner (1932*a*), p. 376.

[6] See E. W. Gardner (1932), p. 405 and Caton-Thompson and Gardner (1932*a*), pp. 377, 388 and 400-402. It is interesting to note that this non-abundance of the rainfall and its torrential character even during the pluvial phases appear also to have characterised the climate in N.

scarcity of the rainfall in the Khargah region, the slight oscillations of climate during the Quaternary were quite *effective* and have been clearly recorded either in the Depression or on the Plateau (and in some cases in both). These oscillations have been recently worked out by Caton-Thompson and Gardner and we propose first to give a summary of the main results of their work, and then to comment. From Diag. 4 A (our Pl. V), it is clear that there were two main phases of rainfall, the latter of which having two sub-maxima. Taken as a whole, the Pluvial Period began to give way in Up. Palaeolithic (Atirian) times, though desert conditions did not establish themselves until the so-called Capso-Tardenoisian [1]. The two maxima of the last Pluvial took place within a single cultural phase (the Mid. Palaeolithic or Acheuleo-Levalloisian) [2]. Three series of "wadi-tufas" were formed during sub-phases of relatively decreased run-off of water, *i. e.* a) after the second sub-maximum, b) between the two maxima, and c) before the first one [3]. In these tufas and their associated deposits of the Second Pluvial were discovered both fresh-water and land shells [4]. They indicate that faunal migration over the S. Libyan Desert was much easier than to-day [5]. This Second Pluviation was preceded by a

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Egypt. In the Sinai Peninsula, some of the pluvial formations were of such a mixed character (big boulders mixed with fine material) that O. Fraas (1867, p. 28), had the illusion that they were formed by glaciers. This view has of course long been discounted (see reference in Ed. Hull, 1886, p. 86 note). The correct explanation is probably that precipitation largely took the form of occasional storms. A similar confusion between torrential and glacial material has also been recently made in the region of the Middle Euphrates (see reference in E. Passmard, 1926 *a*, p. 365).

[1] See G. Caton-Thompson and E. W. Gardner (1932 *a*), pp. 384 and 387.

[2] See Caton-Thompson and Gardner (1932 *a*), p. 404; also E. W. Gardner (1932), p. 403. The first of these sub-maxima was more pronounced than the second (see Caton-Thompson and Gardner 1932 *a*, p. 392). Its advance phase is equated with an industry belonging to an Up. Acheulean facies. Also *vide infra*, Part II, Section i.

[3] See E. W. Gardner (1932), p. 404.

[4] Among the fresh-water shells were : *Hydrobia Peraudieri* Bgt., *Limnaea Caillaudi* Bgt., *Melanoides tuberculata* Mill., *Planorbis alexandrinus* Ehrb. and *Euccinea Cleopatrae* Pallary. The land shells were of a definitely mixed character. They included : *Pupoides* (*Leucochiloides*) *sennaaricus* Pfeiffer, *Zootecus insularis* Ehrenberg (both Egyptian forms) : *Euconulus fulvus* Müller, *Vallonia excentrica* Sterki, *Vertigo antivertigo* Drap. (all Palaearctic) and *Gasterocopta insula* Preston and *Pseudopeas saxatile* Mordet (both C. African). See E. W. Gardner (1932), p. 395.

[5] See Caton-Thompson and Gardner (1932 *a*), p. 399. This is also shown by the discovery of stones of a wild date (*Phœnix sylvestris*) in a fossil spring deposit belonging to this pluvial phase.

dry Interpluvial, during which breccia was laid down in the Scarp valleys, while loess-like deposits spread over the floor of the Depression [1]. Towards the close of this phase slight crust movements took place in the Depression and led to the outburst of springs which flowed all through the Second Pluvial [2]. The Interpluvial was also preceded by another important pluvial phase. During the advance of this phase tufa was formed on the Plateau, while at its maximum many longitudinal and transversal valleys were cut or deepened on the Scarp [3]. Little is known about what happened during this phase in the bottom of the Depression; but it appears that ordinary agents of sub-aerial erosion (wind, rainstorms, etc.) were actively at work. The First Pluvial is very roughly dated as Pliocene and/or Plio-Pleistocene [4].

From this summary of the results arrived at by Caton-Thompson and Gardner it is clear that their work in the Khargah Depression (and Scarp) throws considerable light on the oscillations of climate in that region during Quaternary times. These results, however, were based both on geological and archaeological facts brought to light by field work and on an interpretation of these facts to fit in with assumed cycles of erosion and deposition, especially on the E. Scarp of the Depression. It should be noted, on the other hand, that interpretations relating to such physiographic cycles in sub-arid and arid regions (as the Libyan Desert) are still subject to controversy. While these authors consider that erosion and cutting of valley beds

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This date now inhabits Ruwenzori and the Salt Ranges of the Punjab. See Gardner (1932), p, 409 and Caton-Thompson and Gardner (1932 *a*), p. 384.

[1] The formations of the bottom of the Depression were regarded by H. J. L. Beadnell (1909), pp. 110-122 and map facing p. 50) as belonging to a "pre-historic lake". They have now been classified by Caton-Thompson and Gardner (1932 *a*, pp. 380-382), who deny the existence of a lake, into three categories—*a*) loess-like wind deposits, *b*) fossil-spring deposits, and *c*) historic well deposits. It appears that the fresh-water shells (*Melania* and *Limnaea*) which Beadnell (1909, pp. 115-116) discovered in some of these formations, may have belonged either to some historic well deposit (class *c*) or to some miniature lake (or pond) formations which might have been laid down on a limited scale (in conjunction with torrential streams) during the Pluvial Period. Gardner herself (1932, p. 412) admits that no shells were found in the fossil-spring deposits.

[2] See E. W. Gardner (1932), pp. 417-418.

[3] See E. W. Gardner (1932), p. 401.

[4] This is only very approximate and there is no reason why it should not have continued well into Pleistocene times. *Vide* correlations *infra*.

correspond to maxima of rainfall, they admit, at the same time, that deposition of gravels, silts and tufas also represents pluviation [1]. This would rather lead to some contradiction (explaining both cutting and deposition by same or similar phenomena). It may be also noted that in the physiographic cycles which these authors correlate with the 2nd Pluvial of the Khargah Scarp they start each cycle by deposition followed by erosion [e. g. at the beginning of the Second Pluvial there was, according to their interpretation, deposition of gravels, silts and tufa, followed by cutting of new valley beds in the same deposits] [2]. This does not fit in with the admitted order in physiographic cycles which usually start with cutting, preparation and regulating of valley beds (*i. e.* erosion), and lead on to deposition of gravels etc. on the prepared surface of the bed. Furthermore, we should note that in the Mid. (and parts of the Up.) courses of drainage systems on the Khargah Scarp (as in Egyptian deserts in general) there are two types of valleys : the V-shaped primeval valleys cut in the solid rock and the steep-sided inner ones cut and *emboîtées* in the gravels and other soft (*drift*) materials choking the primeval valleys. The erosion of the first group must have corresponded to particularly high pluviation accompanied by lateral destruction and erosion (to produce the sloping sides of valleys even in the case of a limestone plateau). The material eroded was mostly carried by the strong and relatively regular (through seasonal) current towards the *zones d'épandage* (fan-deltas) in the lowermost courses of the valleys; with the result that little or no gravel was accumulated in the uppermost courses. Apparently these conditions were largely prevalent in Egyptian deserts (including Khargah Scarp) during the 1st Pluvial. The cutting of the *emboîtées* valleys in the gravels and soft materials, on the other hand, can best be accomplished during phases of decreased pluviation or even of aridity (with intermittent rain-storms leading to irregular torrential activity). We may notice at the present day that new steep-sided valleys are continually being cut in soft material by the action of occasional torrents descending from the upper reaches of the valleys and cutting their way through the gravels etc. which

[1] See their discussion in (1932 *a*), pp. 389-397.

[2] See their work (1932 *a*), pp, 391-392 and Figs. 3 and 5.

choke the L. and Mid. parts of the primeval valleys. In this respect, it should be noted than even Caton-Thompson and Gardner admit that valley beds in the Khargah Scarp have been much deepened in the present stage of aridity [1]. It would be much safer, therefore, to attribute the cutting of inner valley beds in gravels and other soft formations to phases of limited rainfall and not to maxima of pluviation. During such phases there would be a shrinkage in the discharge, and the small amount of running water would become limited to a part of the valley floor which it cuts down. As for the deposition of the regular series of gravels, silts and tufas in the Mid. (and parts of the Up.) courses of streams, this can best be attributed to phases of abundant discharge, when the waters would spread over a wider bed often covering the whole of the valley floor. The widening of the actual bed of running water would naturally lead to a slackening in the velocity; thus minimizing the torrential character of the run-off. This renders possible the deposition of gravels, especially in Mid. (and parts of Up.) courses of streams. These gravels, in their turn, tend to reduce the velocity of waters running over them [2]. This gradually leads to deposition of silts and then of tufas overlying the gravels [3]. If such an interpretation be accepted, it would mean that the three series of Wadi tufa which Caton-Thompson and Gardner attribute in the valleys of the Khargah Scarp to three phases of relatively reduced rainfall

[1] See their work (1929 *a*), p. 396 and Fig. 4.

[2] Gravelly floors reduce the surface discharge and velocity of running waters, as part of these latter percolates into the gravels and forms a subterranean stream. On the other hand, a solid and rocky floor would help to maintain the velocity of running water.

[3] The three series of so-called Wadi tufas of the 2nd Plurial of the Khargah Scarp grade in regular deposits of base gravels capped first by silts and then by tufas. If any meteorological inference could be made from this gradation it is that there was a gradual decrease in precipitation (within each series), leading to decline in run-off and transporting power. According to Fig. 5 of Caton-Thompson and Gardner (1932 *a*, on p. 396) which we reproduce on our Pl. V, Diag. 4 A, this can be true only of the last (third) series of Wadi tufas. According, on the other hand, to our scheme represented on Pl. V, Diag. 4 B, this can be said to be true of the three series of Wadi tufas, each of which representing a sub-maximum of pluviation gradually giving way to relatively decreased rainfall. As Caton-Thompson and Gardner themselves point out (1932 *a*, p. 395), the decrease in the run-off and eroding power leads to the development of blockages and boulder barrages which cause ponding, and thus favour the formation of tufas.

following upon, separating and preceding the *two* suggested sub-maxima of rainfall in the 2nd Pluvial can better be attributed to *three* sub-maxima of the same Pluvial. On our Plate V, Diags. 4 A and 4 B we have given a simplified representation of the interpretation made by Caton-Thompson and Gardner, on the one hand, and of the one we have just attempted to outline, on the other.

The importance of this rather long digression into the nature of cycles of erosion and deposition in sub-arid and arid regions is to show the difficulties which workers often meet in interpreting morphological features. In the present state of our knowledge, such interpretations must remain subject to controversy and correction[1]. As we have just seen, the facts collected by Caton-Thompson and Gardner relating to the 2nd Pluvial of Khargah can be interpreted as denoting its division into either *two* or *three* sub-phases of increased pluviation (*i. e.* sub-maxima). The settling of this point cannot be accomplished until we have known more about cycles of erosion and deposition in similar regions. But further light will be thrown on the problem when we compare it with adjacent regions, especially in Palestine, a little later.

Summary of Climatic Record in Egypt.

If we may now sum up the story of climatic changes as we at present know it in Egypt, the following may be noted (see Tables VIII-IX below):

1) In Neolithic and early historic times (roughly 5500 B. C. at least down to 2500 B. C.) there was a very slight, but sufficiently effective increase in the rainfall. This is noted in both the Fayyoum (where the falling lake had two or three pauses) and the Plateau of Khargah[2]. For purposes of convenience we propose to call this phase as the "Neolithic (*sensu lato*) wet phase".

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[1] We are fully aware that the interpretation we have outlined above is by no means comprehensive, and that it cannot be immune from criticism. We have not dealt with the Plateau tufa of the First Pluvial because it has not been studied in detail and its date has not been fixed upon archaeological data as in the case of the Wadi tufas of the Second Pluvial. Also conditions during the Interpluvial (separating the 1st from the 2nd Pluvial) still need clarification.

[2] It may be also added that there is some circumstantial evidence (mainly malacological) from the Fayyoum that this so-called Neolithic wet phase was relatively warm (see E. W. Gardner 1932*b*; also 1934*b*, p. 17). Northern elements such as *Planorbis planorbis*, *Lymnaea lagotis* and the *Pisidia*

2) The Pluvial Period proper began to give way to semi-desert and desert conditions in Upper Palaeolithic times. In Upper Egypt, the process of desiccation appears to have started a little earlier than in the North.

3) In the Quaternary (including also end of Pliocene) there were two distinct Pluvials. The Second of these had three sub-maxima (or at least two, according to interpretations by Gardner and Caton-Thompson) in the Khargah region. In the Fayyoum the story is complicated by the connection with the Nile. The existence of an earlier (First) Pluvial is well ascertained in both N. and S. parts of Egypt, but no details of its oscillations are available.

4) So far as is known from both N. and S. Egypt, only one real Interpluvial existed. There are evidences of slight crust movements in the Khargah at the end of this interval.

PALESTINE AND SYRIA. EVIDENCES OF QUATERNARY AND RECENT CLIMATES.

Physiographic Evidence.

We may now pass eastwards to Palestine and Syria. It has already been mentioned that at least during one phase of the Quaternary glaciers were formed on the Lebanon (*vide supra*, p. 58). Not only are there moraines, etc., but also the present fauna, especially birds, includes some residual cold-loving elements. Among these are *Montifringilla nivalis*, *Octocoris penicillata* (cf. *O. alpestris*), *Pyrrhocorax alpinus* and several other non-migrant birds which must have advanced southwards from the Alpine Belt of mountains during a recent cold phase[1]. It was first thought that the existence of such a cold phase is supported by Pleistocene faunal evidence from Palestine, but this has been rendered somewhat doubtful by more recent palaeontological works[2]. The best evidences of climatic changes, however, have so far come from Palestine, especially the Jordan-Dead Sea trough. In the opinion of M. Blanckenhorn (*vide supra* footnote 3 on p. 82), the physiographic data

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get extinct after having existed in late Pleistocene deposits. See also reference to possibility of warm conditions in the Neolithic in G. Caton-Thompson 1934*b*, p. 84.

[1] H. B. Tristram (1884), p. xxi.

[2] Compare L. Picard's work (1933), pp. 106 and 108 with his work (1937), pp. 60 and 66.

from Palestine coïncide in a remarkable degree with those from the Nile Valley, and may even be correlated with evidences from the Alps. According to an earlier scheme of his [1] (see Diag. 5 A. on our Pl. V) there were two main pluvial phases (the "*Kleine*"—smaller and later—and the "*Grosse*" Pluvial) during which terraces and other accumulation forms were deposited. Each of these Pluvials had two clear-cut maxima, separated by what may be regarded as an Inter-pluvial. The last of these four maxima corresponded to the bottom of the Wadis (both in Palestine and in Egypt), while the third one coïncided with a 2-10 metres terrace (*Mittelterrasse*). To the "*Grosse*" (or Great) Pluvial were attributed various terraces ranging from 10-70 metres. The second of the two maxima of this early Pluvial was more pronounced than the other three, and it corresponded to the "*Höhepunkt*" of the Diluvium. It was followed by a very long and well marked Interpluvial which this author equates with the Mindel-Riss Interglacial of the Alps [2]. The two pluvial phases are also correlated with the Würm and Riss on the one hand and the Mindel and Günz on the other. Later on, however, this author changed some of his correlations [3]. As is clear from Diag. 5 B on our Pl. V. his "*Kleine*" (or Little) Pluvial is limited to the last of the four maxima, which he now equates with the Lower terrace (2-10 metres) instead of the bottom of the Wadis. This means that he now attributes more importance to the last maximum than he did before [4]. The deepening of the Wadis (*i. e.* the "cutting" of the face of the L. terrace) was done in Post-Pluvial times, which were marked by increasing aridity. The earlier (*Grosse*) Pluvial was made up of the three other maxima, the latter of which (and not the middle) representing the "*Höhepunkt*" of pluviation [5]. As regards correlations with

[1] On his old view see his works (1910), pp. 425-428 (1910*a*), pp. 447 ff. and Table (1914), pp. 52-53 and (1921), pp. 151-172, especially, p. 171.

[2] M. Blanckenhorn (1910), p. 426. His Interpluvial phases were characterized by erosion.

[3] On his new view see his work (1921*a*), pp. 8-12 and Table. Still more recently this author appears to have become more and more hesitant about definite correlations with Europe (see his work, 1931, p. 39).

[4] In his view the "*Kleine*" Pluvial was also marked by cold conditions (according to evidence of fauna), see (1921*a*), pp. 10-11.

[5] See M. Blanckenhorn (1921*a*), p. 9.

the Alps, the basis of Blanckenhorn's views remains unchanged, but of course the 2nd Pluvial is equated with Würm alone and the 1st one with Riss, Mindel and Günz together [1].

It may be gathered from this that although Blanckenhorn's conclusions and correlations were not improbable, they were essentially based on a subjective interpretation and correlation of the physiographic data. A more up-to-date geological study has been recently done in the Jordan Valley by L. Picard [2]. Although he, also, arrives at the conclusion that there were two main Pluvials (followed by a very slight, and perhaps somewhat indefinite wet phase), his cycles of erosion and accumulation, and of crust and volcanic movements are more definite than those of Blanckenhorn. According to his scheme the slight Post-Pluvial wet phase may have corresponded, in part, with Mesolithic cultures which survived in this region till comparatively later dates [3]. At the beginning of this phase there was a slight volcanic disturbance. Before the amelioration of climate there was a period of increasing desiccation (the so-called *Jungdiluvium*) during which beaches (such as the Jericho terrace) were left high on the borders of the drying lake of the Jordan trough [4]. The Sea of Tiberias formed a shrinking salt-lake. This was apparently a period of tranquillity in volcanic activity. It was preceded by the Second Pluvial

[1] In a reference to Blanckenhorn's views, P. Woldstedt (1929, p. 285) and E. Nilsson (1931, pp. 336-337 and 339), state that he correlates the 1st Pluvial with the Alpine Riss alone. It is clear from Blanckenhorn's accounts, however, that he still includes in this Pluvial the three maxima which he equates with the Riss, Mindel and Günz Glacials of the Alps although at the same time he considers the third maximum (equivalent of Riss) as the most important (see his work 1921*a*, pp. 8-9).

[2] See his works (1932) and (1933), pp. 93-115; also his work (1937), pp. 68-69.

[3] On this phase, which he calls "Pluvial C", see L. Picard (1933), pp. 108-109 and 113. According to this author, the main part of this wet phase was practically over by the end of what he calls "Final Capsian". We shall see in Section III of Part II of the present work, however, that the Natufian (Final Palaeolithic) survived in N. Palestine till about 4000 B. C. (or even later?). In a later publication (1937, p. 69), L. Picard hesitates to consider this wet phase as a real Pluvial. At the same time, however, he mentions the existence of a greyish-black marshy loam (though only of local extent) which in his view may point to greater humidity and a warmer temperature, coïnciding in time perhaps with the Climatic Optimum of N. Europe, *ibid.*, p. 69.

[4] See L. Picard (1933), pp. 106-108.

(Pluvial B, so-called *Mitteldiluvium*), during which the rainfall was of a wet Mediterranean type, while the temperature may have been rather low (especially in its first part)[1]. Taken as a whole, this pluvial phase was attended first by relatively strong erosion, then by deposition which led gradually towards a regular alternation of clays and sands (indicating seasonal precipitation?)[2]. Before this Second Pluvial there was a fairly important "Interpluvial" (end of his *Altdiluvium*)[3]. Conditions were particularly arid and red earth was formed. Sub-aerial weathering took place, but no terraces or similar accumulations were formed. It was also a very important phase of volcanic activity, and a basalt covering was spread over the plateau as well as on the valley sides and bottoms. This basalt sheet still covers wide areas of the plateau in the direction of Dimashq (Damascus), and is a clear indication that later pluvial conditions were never strong enough to remove or even dissect the lavas. Before the volcanic outpourings, on the other hand, there was a long pluvial phase (his Pluvial A, or the *Altdiluvium*)[4]. This was by far the most important physiographic phase of the Quaternary. Erosion and (later) deposition took place on a larger scale than in the 2nd Pluvial. It was particularly marked by the formation of the so-called Naharaim Gravel Beds which appear to indicate violent torrential activity over a fairly protracted period. Before the deposition of these gravels, there was probably a phase of relative aridity with some basaltic overflows. There are clear indications, however, that the advent of the Diluvium was heralded not only by the gradual oncoming of wetter conditions, but also by a conspicuous movement

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[1] On this Pluvial see L. Picard (1933), pp. 105-106.

[2] According to this author the Palestine rainfall during the Pluvials of the Diluvium was of an "intensified Mediterranean type" (*i. e.* heavier winter-precipitation with dry summers). We have already seen however, that, on the evidence of fossil flora in an adjacent part of the Mediterranean (the Ægean), the summers of at least one pluvial phase could not have been as dry as they are to-day (*vide supra,* p. 58). Of course the pluvial climates may have been more favourable in the Ægean than in Palestine, but it appears that at least during the formation of the so-called *Naharaimschotterstufe* (to be mentioned presently) of the 1st Pluvial, summer rain-storms must have been fairly frequent.

[3] On this Interpluvial see L. Picard (1933), pp. 103-105.

[4] On the First or Main Pluvial see L. Picard (1933), pp. 101-102.

of mountain uplift which opened a new chapter in the physiographic history of Syria and Palestine[1].

Faunal Data and their Interpretation.

Before we summarize the diluvial climates of Palestine and proceed to compare them with those of Egypt, a few words must be said of the fossil fauna from that country. Unfortunately all the remains hitherto discovered (mostly from caves) appear to belong to one part of the Pleistocene; *i. e.* the 2nd Pluvial and after[2]. The bones excavated from the Natufian ("surviving" Palestinian Mesolithic) layers of the Mugharat al-Wad, Mt. Carmel, belong essentially to a fauna of a semi-desert type; but in any case they indicate better rainfall than to-day[3]. The Upper Palaeolithic proper was characterized (in the Mugharat al-Wad) by decreasing rainfall (compared with earlier times). Both desert gazelles and steppe-land deer (*Dama mesopotamica*) occur in its layers[4]. The proportion of these two types to one another, however, in the successive layers of the Up. Palaeolithic of Mugharat al-Wad (cave) may be of some interest as it throws useful light on vegetational and climatic changes. At first (layers F and E) gazelles preponderated, then (layer D) deers became in majority, and finally, towards the end of the Upper Palaeolithic (layer C), gazelles preponderated again[5]. As *Dama mesopotamica* needs more forest conditions than the so-called desert gazelle, it may be permissible to accept

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[1] See L. Picard (1933), pp. 98 and 109-110. It is interesting that this uplift was not accompanied by any basalt flows, which characterize the posterior crust disturbances and faulting.

[2] For earlier references to animal finds see H. B. Tristram (1884), p. xxi. More recent and more reliable accounts may be found in D. M. A. Bate (1927), pp. 9-13 and 27-52 and (1932), pp. 277-279; R. Vaufrey (1931*a*), pp. 353-363; D. A. E. Garrod (1934*b*), pp. 142-148; D. A. E. Garrod and D. A. M. Bate (1937); and L. Picard (1937), pp. 59-68.

[3] See D. M. A. Bate (1932), pp. 277-279. It should be noted that the greater part of the finds belong to various types of gazelles which may not give an exact idea about the amount of rainfall. It appears, however, that the last wet phase of Picard (Pluvial C), which was rather indefinite, did not have any conspicuous effect upon the fauna.

[4] See D. M. A. Bate (1932), p. 278 and D. A. E. Garrod (1934*b*), p. 142; also their more recent work (1937).

[5] D. Garrod and D. Bate (1937) and Bate's graph reproduced in R. Vaufrey (1939), Fig. 10.

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the possibility that during the Upper Palaeolithic there existed a succession of two relatively dry (or less rainy) sub-phases separated by a relatively wetter one [1]. At an earlier stage in Palaeolithic times (the Upper Mousterian of the Tabun Cave, level or layer B) the fauna was almost entirely composed of *D. mesopotamica* and another species of red deer [2]. The climate was somewhat wetter than in the succeeding Upper Palaeolithic. In the Lower Mousterian of the same cave animal remains were very abundant. Although gazelle bones were in majority over deer bones, there existed a number of other animals which needed a high water supply (or at least required the existence of marshes in relatively favoured spots). These included *Hippopotamus* sp., *Crocodilus*, a large form of water tortoise and *Rhinoceros* cf. *hemitoechus* [3]. Apparently this fauna (including both Asiatic and African types) coïncided with a phase of faunal migrations in various directions. The abundance of gazelles, however, makes it difficult to consider it as representing a maximum of pluviation. In the preceding phase of the Upper Acheulean and Acheuleo-Mousterian the fauna of the Tabun Cave was largely made up of deers with only a minority of gazelles [4]. The Rhinoceros appears for the first time in this phase, but the hippopotamus is still absent [5] Animal remains thus indicate that the

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[1] We may note, however, that some authors like L. Picard do not accept D. Bate's conclusions that more frequent finds of bones of *Dama mesopotamica* and *Cervus elaphus* indicate more humid conditions and wooded landscape, while more frequent finds of gazelles (so-called desert gazelles) indicate drier climate and open landscape. Among other considerations (mentioned by Picard) chance may play a big rôle in the hunting booty of a prehistoric community whose relics have thus far been found only in a limited number of Palestinian caves. See L. Picard (1937), p. 66.

[2] See D. A. E. Garrod (1934*b*), p. 144.

[3] Also a tooth of a wart-hog was found in a comparable level in the Mugharat (= cave) es-Skhul; see D. Garrod (1934*b*), pp. 144 and 146. Remains of Rhinoceros were also found in Mugharat al-Amirah and Mugharat Zuttiyah (in the latter accompanying a L. Mousterian or Acheuleo-Mousterian culture), and in the Nahr al-Kalb in Syria. See D. Bate (1927), pp. 12-13 and 28; also R. Vaufrey (1931*a*), p. 254.

[4] D. Garrod and D. Bate (1937) and Bate's graph reproduced in R. Vaufrey (1939), Fig. 10.

[5] On the absence of the Hippopotamus from the layer underlying the Mousterian at Zuttiyah see D. Bate (1927), p. 26. It is interesting that the Hippopotamus which makes a late appearance also disappears before other members of the fauna. Although its absence from the Up. Mousterian may be simply due to negative evidence, it is possible that it became rare (or extinct) owing to cooler conditions.

Upper Acheulean and early Acheuleo-Mousterian represent the advance-phase of a Pluvial [1] which continued, with oscillations, during Middle and Upper Palaeolithic times, until it gradually gave way to desert, or semi-desert, conditions (at the close of the Up. Palaeolithic). Indeed the bulk of fossil fauna from Palestine belongs to one and the same pluvial phase — the 2nd Pluvial or Pluvial B of L. Picard (*vide supra*) [2]. The exact sequence of oscillations within this Pluvial is an open matter as it depends on divergent interpretations of faunistic data. If we take into consideration only the big fauna, requiring an abundant supply of water, this Pluvial world represent a phase which started in the Up. Acheulean, reached its maximum in the L. Mousterian and fallen away in the Upper Mousterian and the Upper Palaeolithic. Such a conclusion which gives the 2nd Pluvial a simple and non-oscillating curve (advance-phase, maximum pluviation and gradual decrease) is, however, open to criticism. In the first place, we should note that remains of big and water-loving fauna thus far discovered (such as Hippos) are still un-abundant, and it may not be safe to draw from them any definite or detailed conclusions. Secondly, the possibility of the "survival" (during relatively less rainy intervals) of some of these animals (such as crocodile or water-tortoise) in particularly favoured spots (near springs etc.) renders them unsafe as criteria for climatic oscillations. Thus the uniform and un-interrupted curve of pluviation (in the 2nd Pluvial) as deduced from remains of water-loving fauna may only be an apparent one. If, on the other hand, we base our interpretation of past climatic changes on the proportion of open-forest deers and desert gazelles to each other (*vide supra*), this 2nd Pluvial of Palestine

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[1] Working purely on archaeological evidence D. Garrod has at first (1934*b*, p. 150) reasonably correlated the Palestinian Upper Acheulean with the close of the Riss-Würm Interglacial of the Alps. In a later publication (Garrod and Bate 1937), however, she seems to have accepted theoretical correlations (of glacial and pluvial episodes) which would equate the Up. Acheulean of Palestine with the close of the Riss Glacial; see reference in R. Vaufrey (1939), p. 401. The delicate problem of correlation of Pleistocene climates and cultures in different latitudes will be touched upon a little later and also in Part II of the present work.

[2] The formations of the 1st or Main Pluvial, on the other hand, have yielded very few fossil remains, among which are the only elephant bones (*Elephas trogontherii* Pohl) thus far recovered from Palestine. See L. Picard (1937), p. 68.

would have 3 sub-maxima coïnciding with the Upper (or Uppermost) Acheulean (or Micoquian), the Upper Mousterian and part of the Upper Palaeolithic [1]. These sub-maxima were separated by two phases of relatively decreased precipitation (with more gazelles than deers) in the Lower Mousterian and the early part of the Palestinian Upper Palaeolithic. This latter interpretation, however, leads to a certain amount of controversy in the case of the Lower Mousterian, as the abundance of desert gazelles in this phase coïncided with an increase in animals requiring relatively abundant water supply. Perhaps the truth lies in an interpretation between the two—namely that the 2nd Pluvial of Palestine had 3 sub-maxima, the first two of which (in the Uppermost Acheulean and the Mousterian) merging into (and not being really distinguishable from) one another. The last sub-maximum (during part of the Up. Palaeolithic, layer D of Mugharat al-Wad) was less important and only slightly marked. Towards the close of the Upper Palaeolithic, this Pluvial gradually gave way to desert or semi-desert conditions, which have eversince (possibly with the exception of Pluvial C of L. Picard, *vide supra*) prevailed in Palestine.

Summary of Climatic Record in Palestine.

If we may now sum up the story of climatic changes in Quaternary and later times, as we may glean them from both physiographic and faunal (thus far still fragmentary, and in part even contradictory) data from Palestine, we may conclude that, on the whole, there existed two major Pluvials and a later wet phase [Pluvial C of L. Picard(?) whose existence and nature are still indefinite]. The 2nd Pluvial was less marked than the 1st one, but we know more about its details. On the whole, the amount of precipitation appears to have been gradually decreasing during this phase, especially towards its close. It is possible, however, that it had a number of minor oscillations amounting to three sub-maxima (though the first two of these latter were apparently indistinguishable from one another). Taken generally, the fauna of this Pluvial does not indicate a temperature much different from that of

[1] D. Garrod and D. Bate (1937); and Bate's graph reproduced in R. Vaufrey (1939), Fig. 10.

the present day, but the extinction during its middle and later parts of certain types of big and warm fauna (Hippo etc.) may perhaps indicate a gradual onset of relatively cooler (instead of warm temperate) conditions (?) [1]. Between the two Pluvials there existed a dry interval (an Interpluvial) which was also marked by volcanic activity. It was preceded by the 1st Pluvial which was the "Main" one, though hardly anything is known about its climatic details or its fauna. It probably started in the Pliocene and was heralded by a phase of land uplift (which had apparently begun earlier in the Tertiary).

Correlations with Egypt.

In the light of the material we have just reviewed, it may not be unsafe to attempt a correlation of the Pluvials of Egypt and Palestine. This may be given in tabular form as below (Table VIII), but the following "checking" points may be also added : 1) The last wet phase was very slight, but sufficiently well marked in Fayyoum and Khargah and apparently also in Palestine. On the evidence of the Fayyoum, it may be *roughly* dated as from the middle of the 6th mill. to the middle of the 3rd mill. B. C. For purposes of convenience we may term it as the "Neolithic" (*sensu lato*) wet phase. There is some evidence that this phase may have been slightly warmer than at present. 2) The evidence is fairly conclusive in both countries as to the gradual on-coming of arid conditions in Up. Palaeolithic (as compared with earlier) times. 3) The 2nd Pluvial synchronized roughly with the same culture-stage (Uppermost Acheulean, Mid. and part of Up. Palaeolithic) in both Palestine and Egypt. In both countries it appears to have had more than one sub-maximum—probably three, the first two of which not being clearly distinguishable from one another. 4) There is only one real "Interpluvial", and it was marked in Palestine by volcanic activity and in Khargah (towards its close) by slight faulting and spring out-bursts (at the beginning of the

[1] The relics of the Alpine fauna (especially birds) still surviving in the Lebanons down to the present day (*vide supra*, p. 95) may have migrated southwards during a relatively cool stage or sub-phase of either the 2nd or the 1st Pluvial.

2nd Pluvial). 5) The 1st Pluvial was by far the most important physiographic phase in both countries and it started in the Up. Pliocene or the Plio-Pleistocene (though it continued much later). Unfortunately, no evidence is available as to the details of this phase. 6) The 1st Pluvial appears to have been preceded by a gradual elevation of the land in N. E. Africa [1] and by a movement of mountain uplift in Palestine and Syria.

TABLE VIII.

Tentative correlation of Quaternary and Recent climates in Egypt and Palestine. (Based on references mentioned in footnotes on pp. 81-102. The Table reads upwards and no time-scale is attempted.)

PHASES.	EGYPT.		PALESTINE.
	FAYYOUM.	KHARGAH.	
"Neolithic" wet phase.	Two lake-levels at 10 m. and -2 m. (with step at 4 m.).	More frequent rain-storms on Plateau.	Pluvial C. of L. Picard?
Phase of increasing desiccation.	Increasing desiccation. Degradation of Nile. Drying up of Lake.	Drying up of fossil springs. Increasing aridity on Plateau.	Increasing aridity. More and more semi-desert fauna.
2nd Pluvial.	Pluvial conditions. Perhaps more than one sub-maximum. Connection with Nile.	Second Pluvial. With three (or perhaps only two?) sub-maxima.	Pluvial B. Apparently having two or three sub-maxima.
Interpluvial.	Desert conditions,	Desert conditions. Slight faultings at end.	Arid conditions and volcanic activity.
1st Pluvial.	Long Pluvial. Details unknown.	Long Pluvial. Details little known.	Pluvial A. Very long and important. Details unknown.
Pre-Diluvial.	?	?	Land uplift.

[1] However, this movement of elevation in N. E. Africa did not take place immediately before the 1st Pluvial, which was in no way related to it. The rise started in the Miocene or perhaps the late Oligocene, and had a great effect upon the succeeding cycles of erosion and deposition. In the L. Pliocene the sea rose again in relation to land (or the land subsided slightly?). *Vide infra*, the Appendix at the end of present Part. In Palestine and Syria, on the other hand, the uplift seems to have continued longer than in Egypt.

Evidences from other Parts of Near East.

Evidences relating to climatic changes in other parts of the Near East are still very scanty. Apart from general accounts about diluvial Wadis, hardly anything is known as yet about the story in Arabia proper. A small, but interesting point, however, has come to light in one of the journeys by H. St. J. Philby [1]. On the N. side of the Rub' al-Khali, gravel spreads and other water deposits (perhaps lacustrine), containing fresh-water shells have been discovered. They have also yielded (in profusion on their surface) some stone artefacts of a "Neolithic" facies [2]. The complete aridity of the area at the present (and probably also in historic times) [3] is incompatible with the existence of a culture using these implements. It is not improbable that we have here an indication of better climate in "Neolithic" or proto-historic times.

On the borders of Mesopotamia there are abundant traces of former climatic changes. On the banks of the Middle Euphrates and widening on both sides of it are terraces at ± 15 metres, 30 metres, 60 metres, and 100 metres, above the river [4]. Although such terraces may be partly attributed to other factors than changes of climate, there can be little doubt that, during one or more phases of its recent geological history, the Euphrates discharged more water and material. Gravel spreads in its Middle and Upper parts are an indication of former torrential activity. In the adjacent region of Kurdistan there are traces of former glaciation in the form of moraines,

[1] See his work (1933), p. 11.

[2] The implements, kept at the British Museum, were examined by the writer, with kind permission of the Keeper of the Dept. of Antiquities. *Typologically* they could all be regarded as "Neolithic". Of course the term "Neolithic" is used here in an even looser sense than we have so far used it. It refers roughly to the interval between the Final Palaeolithic and the historic phase proper.

[3] We need not enter here into the question of historic climates of Arabia. Suffice it to indicate that although other parts of Arabia certainly had a better rainfall during intervals of historic times, this does not seem to have been the case with the Rub' al-Khali and its immediate fringes. At any rate, these latter regions could not have received enough precipitation during any interval of the historic phase to make possible the formation of the gravel spreads, etc. mentioned above.

[4] See E. Passemard (1926*a*), pp. 365-368 and (1927*a*), p. 71.

terraces, etc.[1]. The Mousterian culture stage, as represented in the Hazar Merd Cave of this region appears to have coïncided with a phase of intense cold and perhaps also an extension of ice-fields on the mountains[2]. On the Iranian Plateau proper the changes of Quaternary climates have been studied in a general way by E. Huntington[3]. He arrived at the broad conclusion that there was a long series of climatic oscillations (amounting in all to 15 Pluvials or Sub-Pluvials), but unfortunately his evidence is so vague that no useful correlation could be attempted with the neighbouring plains of the Near East.

A TENTATIVE GENERAL CORRELATION OF QUATERNARY AND RECENT CLIMATES ALONG SAHARO-ARABIAN BELT.

Before we leave the arid Belt of the Sahara-Arabia a general correlation of the former climates of its two sections (the W. Sahara and Little Africa on the one hand, and the Near East—as represented in Egypt and Palestine —on the other) may be drawn up. There is no reason to doubt that, on the whole, climatic changes took place simultaneously along the whole Belt[4]. A glance at our Tables VII and VIII (each of which worked out separately) may be sufficient to point out the strong case for such a correlation. Table IX, however, gives a combined system of equation as we see it in the light of available data[5].

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[1] See reference in D. A. E. Garrod (1930), p. 40.

[2] D. A. E. Garrod (1930), p. 40.

[3] E. Huntington (1905), p. 300-302. See also S. Hedin (1910), pp. 331-332.

[4] At present the precipitation along this Belt (apart from certain regions of the C. Sahara) is largely due to westerly depressions advancing along the Mediterranean (or forming over it). Presumably also during the Pluvial Period similar (though stronger and perhaps more complicated) meteorological factors were at work all along this Belt. This question will be further alluded to at the end of the present Part.

[5] In order to make this Table more comprehensive, we have attempted in it to make a correlation not only of past climates (and their associated formations) but also of past cultures. Evidences for past climates have already been dealt with in the preceding pages. Palaeolithic and later cultures will be dealt with in the following Part of the present work. Some modifications and additions have been made to this Table since it has been first published by the present writer (S. Huzayyin 1937-1938, pp. 264-270).

TABLE IX.

Tentative Table of Correlation of Formations, Climates (and Cultures) in the W. and E. sections of the Saharo-Arabian Belt. Based, for W. section chiefly upon : J. Bourcart (1933), (1937); A. S. Romer (1928); R. Maire (1928); P. Pellegrin (1911), (1919); M. Dalloni (1935); P. Pallary (1901), (1923); H. Obermaier (1930); H. Breuil (1931); R. Vaufrey (1933), (1936); R. Chudeau (1921), (1921 *a*); G. Stefanini (1930) and others; and for E. section M. Blanckenhorn (1921), (1921 *a*, *b* and *c*); E. W. Gardner (1932); G. Caton-Thompson and E. W. Gardner (1932), (1934); K. S. Sandford and W. J. Arkell (1933); K. S. Sandford (1934); L. Picard (1933), (1937); D. M. A. Bate (1927), (1932); D. Garrod and D. Bate (1937); R. Vaufrey (1939) and others.

PHASES.	LITTLE AFRICA AND INTERIOR SAHARA.	EGYPT AND PALESTINE.
Historic (post-Roman?)	Present day conditions. Migration or extinction of fauna especially from unfavourable areas.	Present day conditions. Lowering of sub-terranean water-level in Syrian Desert wells.
Retarded Neolithic and Early Historic (circ. 2500 B. C. onwards?)	So-called "Neolithic" dunes (very slightly consolidated). Increasing dryness; but still more wet than to-day. Cultures of Interior Sahara "going up" to toplands of high Massifs. Late rock drawings (some showing Egyptian affinities; e. g. chariots etc.)	Successive tribal disturbances and Semitic migrations from N. Arabia. Disturbances partly associated with climatic oscillations?
"Neolithic" (*sensu lato*) wet phase (circ. 5500-2500 B. C.). Presumably also slightly warmer than at present(?)	Little Africa ; formation of brown and yellow soil (and other alluvia) followed by *Tirs* black earth. These formations are contained in pockets in the *limons rouges* of the Mousterian (*vide infra*). *Tirs* earth indicates semi-forest conditions. Appearance of *El. africanus* (for first time), reed-buck, water-buck and *Hip. amphibius*. Rock drawings(?) including elephants, hippos, big buffaloes (*grands buffles*), lions, panthers,	Egypt : red loam in solution-pans on Libyan desert plateau. Lake-levels at 10 metres above sea-level and -2 metres in Fayyoum. Indications of a wet phase (more marked in the North). Possibly also slightly warmer than at present (evidence of malacological fauna and plants in the Fayyoum?). Palestine : Post-Pluvial wet phase perhaps coïnciding in part with surviving Final Palaeolithic (Natufian)

PHASES.	LITTTE AFRICA AND INTERIOR SAHARA.	EGYPT AND PALESTINE.
	gazelles, sheep, etc. Naturalistic style. Acquatic fauna showing warm or warm-temperate conditions with more abundant supply of water; including types of *Limnæa, Physa, Planorbis, Melania, Melanopsis* and *Corbicula*. Interior Sahara : Naturalistic rock drawings (?) with big fauna. Migration of Ethiopian or Sudanese fauna (mammals and fishes?) from S. to N. across Sahara. Wet phase (and perhaps also warm?). Early Neolithic (as distinguished from "retarded" Neolithic) sites at places now entirely dried up. Unlike historic cultures (whose remains are on tops of hills), Early Neolithic settlements are in bottom of valleys and on deltas (*zones d'épandages* formerly well watered).	industries. Fauna of semi-desert character, but indicating better rainfall than to-day. Pluvial C (?).
Increasing Desiccation.	Little Africa : Onset of dryness marked by formation of surface encrustations on earlier *limons roses* in Tensift valley. Encrustations including Oranian tools (found in profusion on surface) of El-Hank type. Possibly also formation of breccia in some parts (?). Cutting up of the surface of *limons rouges* (laid down in Mousterian), and preparation of "pockets" in which Neolithic soils were deposited at a later stage (*vide supra*). Upper Palaeolithic cultures (e. g. typical Atirian, Capsian and Oranian) accompanied by increasingly drying conditions. Faunal types requiring moderately abundant (and in one or two cases very abundant) supply of water, and which appear earlier in Pleistocene, "skip" over Up. Palaeol. to reappear in Neolithic. These include cerval panther,	Egypt : Gradual oncoming of dryness in Up. and Final Palaeol. Desiccation appearing earlier in Up. Egypt. Wadis of E. Desert drying up and less gravels, sands and silts brought from that direction into main valley (by very occasional torrents). Deposition in this main valley (in Nubia and S. Egypt) due to Abyssinian silt. Old springs in Khargah Depression, whose waters were derived from local rainfall, drying up and becoming "fossil". Palestine : Phase of increasing desiccation. Beaches (such as the Jericho terrace) left high on borders of drying lake of Jordan trough. Sea of Tiberias forming a shrinking salt-lake. Fauna showing gradual increase in desert and semi-desert types towards end of Up. Palaeolithic (e. g. desert gazelles gradually ousting steppe-land deer or *Dama mesopotamica*).

PHASES.	LITTLE AFRICA AND INTERIOR SAHARA.	EGYPT AND PALESTINE.
	bear, wart hog, hippo, buffalo, reedbuck, eland and ass. Interior Sahara : Up. Palaeol. cultures very much limited in distribution (e. g. Tibesti Massif having yielded only L. and M. Palaeol. but not Up. Palaeol., *vide* also map on our Pl. III.) Heart of Sahara drying up towards close of Pleistocene. Possible formation of dunes (now fossil) on S. fringes?	
Pluvial II. Apparently with two or three sub-maxima.	Little Africa : Two sets of formations (possibly representing two physiographic sub-cycles or two pluvial sub-maxima?). The later set including "*limons roses*" (slightly consolidated) in Tensift valley and *terra rossa* in various parts of Morocco. Climate relatively wet. The earlier set represented by red clays (*argiles rouges*), loams and travertines. General regression of sea except at limited places on Moroccan coast. Possible formation of dunes in coastal area (but not necessarily indicating dryness). Heavy rains leading to hydrographic activity in Sahelian caves where red deposits were formed. Strong deposition in valleys of finely cemented sands including Mousterian tools. Fauna of 2nd Pluvial showing mixed character. Besides Sudanese types (antelopes etc.), there is an increase in number of some Eurasiatic animals (such as bear, deer, sheep and goat). Arrival of *Rh. Merckii* (introduced from Europe *via* Palestine) may indicate relatively cool conditions during part of this Pluvial (?). Acquatic fauna also including predominantly palaearctic types.	Egypt : More rainfall in W. Desert, leading to formation of Wadi Tufa (in Khargah area) including remains of some three varieties of *Ficus*, together with Up. Acheulean, Acheuleo-Levalloisian and Pre-Sabilian tools; and also abundant fresh-water and land mollusca of both Northern and African types. Facility of Faunal migrations over what is now a dry desert plateau. Outburst and great activity of springs (now fossil) in Khargah Depression. Evidence from Khargah Scarp making possible the division of this Pluvial into three (or perhaps only two?) sub-maxima, in Fayyoum Lake this distinction between such sub-maxima not being so clear owing to connection with River Nile. In E. Desert, wadis (now dry) descended to Nile Valley and contributed material to build up its lower terraces (presumably 10 metres and 3 metres terraces). Palestine : Rainfall of wet Mediterranean type, and temperature not much different from that of the present day (though it may have become somewhat cooler during part of this phase). Rather strong erosion followed by deposition of brackish sediments etc.,

PHASES.	LITTLE AFRICA AND INTERIOR SAHARA.	EGYPT AND PALESTINE.
	Interior Sahara : Presumably wet and temperate. Migration of animals (and plants?) from Mediterranean, as well as from Sudan, across Sahara. Increase in the mixed character of flora of the Hoggar area (?). Such migrations could only have happened under pluvial conditions.	and, later on, of regular alternations of clays and sands (indicating seasonal precipitation?). Acheuleo-Mousterian deposits including fauna requiring more rainfall and forest conditions; e. g. *Hippopotamus* sp.; *Rhinoceros* cf. *hemitoechus*, *Crocodilus*, a large form of water tortoise, together with *Dama mesopotamica* and another species of red deer. It is possible that this Pluvial had three sub-maxima (the first two of which, however, not being clearly distinguishable from one onother).
Interpluvial.	Little Africa : Surface concretions forming crust of dunes in Morocco. Perhaps dunes themselves formed earlier during same phase? Concretions containing Acheulean tools (apparently Up. Acheulean). Desert climate. Volcanic activity, especially towards close of phase. Land movements and basalt flows in valleys. Early part of phase probably associated with erosion and cutting of new valley-beds into earlier calcareous infillings (of larger valleys) belonging to 1st Pluvial. The newly cut *emboités* beds were, later on (in Mousterian of Pluvial II.), filled in with sandy but well cemented material (*vide supra*). Faunal evidence not clear. Interior Sahara : Presumably very dry? Perhaps formation of early dunes (consolidated later on) on S. fringes of Sahara.	Egypt : Conditions of aridity, especially in S. Egypt. Formation of Breccia in bottoms of valleys on Khargah Scarp. Loess-like æolian formations in Khargah Depression. Drying up of Eastern Desert wadis (?). Slight crust movements in Khargah towards close of phase. Palestine : Arid conditions. Sub-aerial weathering and formation of *terra rossa*. Important volcanic phase. Basalt overflows covering plateau as well as valley sides and bottoms.
Pluvial I (Main Pluvial).	Little Africa : Abundant rainfall and perhaps also rise in temperature (at least during part of phase). Details	Egypt : Main Pluvial. Tufa formations on Plateau in Khargah Desert. Cutting of wadis in limestone Plateau.

PHASES.	LITTLE AFRICA AND INTERIOR SAHARA.	EGYPT AND PALESTINE.
	of Pluvial, however, unknown. Hard lacustrine limestones and perhaps also travertines especially round springs. *Coastal* dune formations (now consolidated) in W. Morocco not necessarily associated with dry climate. Dunes resting on marine (*cordon*) and fluviatile formations with *El. antiquus* and *Hippo amphibius*. Chellean tools of the *carrière Martin*. Perhaps also development of L. Acheulean towards end of phase? Abundance of fauna of both Sudanese or Sub-Equatorial types (hippo, spotted hyaena, lion and panther) and Eurasiatic (deer, bear, sheep, etc.). Two thirds of fauna, however, decidedly African. *Bubalus boselaphus*, requiring warmth and abundant supply of water. Warm mammalian fauna of Palikao (Chellean). Aquatic fauna also rich. Interior Sahara : Presumably wet and warm. Cutting of many wadi-systems in interior Sahara. Migration (across Sahara) of such animals as *Bubalus boselaphus* only possible under pluvial conditions. Rise in temperature (especially in middle part of phase?) rendering rainfall less effective in C. Sahara. Limited areas with Chellean cultures.	Eastern Desert with running water. Abundant material brought from Red Sea Hills to Nile Valley. Building up (in Nile Valley) of 50 metres (?), 30 metres and 17 metres terraces, the last two of which containing L. Palaeol. tools. Apparently a very long and important phase; but details unknown. Palestine : Most important phase of pluvial activity in Quaternary of Palestine. Erosion and (later on) deposition on a large scale. Formation of so-called Naharaim (and other?) Gravel Beds. Details unknown.
Pre-Pluvial (or Pre-Diluvial).	Little Africa : Oncoming of relatively cooler conditions (*refroidissement*) in Up. Pliocene (and later). Gradual increase in precipitation. Interior Sahara : Not known.	Egypt : Gradual increase in rainfall. Fluviatile gravels and sands in Valley and formation of early terraces. Palestine : Pluvial epoch heralded by gradual uplift of land and gradual oncoming of wetter conditions.

In addition to this Table the following concluding remarks may be made as a guide for further correlations to be attempted a little later :

a) So far as the total precipitation is concerned, the Post-Pluvial wet phase (the so-called "Neolithic") was insignificant. Yet its "effective" value for the cultural evolution within this area could hardly be over-estimated.

b) On the evidence of the data we have at hand, only two Pluvials could be distinguished within Diluvial times. This offers an interesting point of contrast with European latitudes. It must be taken into account in any equation of the Glacials and Pluvials.

c) The proportion of the 1st and the 2nd Pluvials is also interesting to note. The part represented by the first of these in the Diluvial history of the Saharo-Arabian Area is by far greater than that represented by any one Glacial in the Quaternary of Europe. Unfortunately, however, little or nothing is known of the details of this early Pluvial.

d) It would also be interesting to keep in mind that, so far as our knowledge goes, there was only one true Interpluvial. It may not have lasted very long, but its effect in separating two physiographic cycles was presumably enhanced by crust movements and volcanic activity.

e) And finally before the Diluvium [1] proper there was a preparatory phase during which land movements (uplifts) took place. There are also fragmentary evidences of gradual cooling (*refroidissement*) in N. W. Africa.

THE SUDANESE, SUB-EQUATORIAL AND EQUATORIAL ZONES.

EVIDENCES OF PAST CLIMATES (QUATERNARY AND RECENT).

The Sudanese Belt. The W. Sudan.

We must now pass southwards to the Sudanese and Equatorial zone which can receive only brief consideration. The question of historic changes of climate on the Southern border of the Sahara does not come up for discussion here, but it is interesting to note that, although the Sahara may be now

[1] On the use of the term "Diluvium" see *Addendum* at end of present Part.

encroaching upon the Sudanese Belt [1], there was at least one phase within the Quaternary when this encroachment was still more pronounced than to-day. "Fossil-dunes" (now fixed with vegetation) occur well within the Sudanese zone [2]. Unfortunately the material available on recent geological climates of this area is very fragmentary. We know, however, that taken as a whole the post-Tertiary physiographic history of the N. E. plateau of Nigeria (Jos) may be divided into two cycles (each of which characterized by erosion and deposition) [3]. These cycles were separated by a phase of volcanic activity (basaltic lava flows). It is not improbable that we have here the equivalents of two pluvial cycles and an Interpluvial (with volcanic disturbance). In the adjoining plateau of Asselar (N. E. of the Niger bend) Boule and Vallois argue for two such physiographic cycles associated with two rather indefinite Pluvials [4]. More detailed data, however, come from the region between the Niger and Tchad, where there are traces of a succession of climatic changes. According to Urvoy, at least the last three of the pluvial sub-phases could be discerned [5]. Of these the last was very slight and could only be traced by its effect upon the sand dunes in the valleys. The two sub-phases before it (especially the earliest one) were much more pronounced. The interval between the second and the third represented an arid phase during which some of the fossil-dunes of the Niger were probably formed. The one between the first and the second sub-phases was less important. It is difficult to attribute any date to these wet phases (or sub-phases), especially as they do not constitute the whole story. Another similar set of evidences from the Lake Tchad Basin, is perhaps more illuminating. In the neighbourhood of

[1] See M. Abadie (1927), pp. 79-80 and E. W. Bovill (1929), pp. 418-420; also A. T. Hopwood (1930), p. 304.

[2] See R. Chudeau (1909), pp. 244-255 (1921*a*), p. 605 and (1925), p. 63; also Cortier (1925), p. 20.

[3] See reference in H. J. Braunholtz (1926), p. 4.

[4] See M. Boule and H. Vallois (1932), pp. 8-17. It should be made clear, however, that this conclusion is not based on sufficient physiographic data. It is suggested that there are two terrace-like levels in the Wadi Tilemsi, one at 50-60 m. (above the bottom of the Wadi) and the other at a still higher and less defined altitude.

[5] Y. Urvoy (1933), p. 507.

the lake there is a series of much obliterated fossil dunes which are now partly covered by a new series of moving ones. It is interesting, however, that although the modern dunes follow the direction of the prevailing winds (N. E.-S. W.), the fossil ones appear to have had a N. N. W.-S. S. E. orientation. This may perhaps suggest that these old dunes were formed during a phase when the main direction of the wind differed from that of to-day (nearly at right angle); but as Aufrère points out we should keep in mind the possibility that they might represent "transversal" dunes [1]. That they were formed before the formation of the Lake Tchad itself is proved by the fact that they actually pass underneath it, and are, in some places, covered by lacustrine clays (indicating higher levels of lake). From the study of the sections of these deposits Freydenberg was able to establish the following succession of expansions and regressions of the lake (starting with the most recent) [2] :

1) Present régime of modern dunes.
2) White *limon;* last transgression of the lake.
3) Roots of plants; slow regression of the lake.
4) Green *limon;* sudden transgression of the lake.
5) Slow regression of the lake.
6) *Limon*; first transgression of the lake.
7) Early régime of dunes (fossil).

Of course it would be feasible to explain this three-fold series of lake expansions (at least in part) on purely hydrographic grounds (deflections, captures, etc. of the feeding rivers); but at any rate the fact that there were only two systems of dunes (one before the lake and the other at present) leads to the assumption that there were no important interpluvial phases within the history of the present lake [3]. There can also be little doubt that this series of

[1] L. Aufrère (1930), p. 227.

[2] H. Freydenberg (1908), pp. 62-63 and section on p. 69; also reference in C. E. P. Brooks (1932), pp. 65-66.

[3] We should perhaps point out that although sand formations may not be always associated with dry conditions (*vide supra* footnote 4 on p. 76), it is practically certain that the fossil dunes of the Sudan Belt and the Tchad Basin indicate former aridity. This is, in a way, shown by the fact that they were entirely controlled by the N. winds which must have always been dry.

lake-levels is of a comparatively recent geological date. In spite of its having no apparent outlet, the Tchad is at present practically fresh [1]. It may appear possible that the three expansions of the lake coïncided with the three most recent wet phases (or pluvial sub-phases) distinguished by Urvoy in French Nigeria (*vide supra,* p. 113). This coïncidence, however, cannot be proved beyond doubt. It is even more probable that the series of three expansions in the Tchad may have corresponded to the two earlier wet phases of Urvoy and a still older one not discerned by him. As we have already mentioned, his last wet phase (or sub-phase) was preceded by a much drier interval (with dunes) than we find between any two of the Tchad oscillations. If this be accepted, it would mean that the three expansions of the Tchad represented three sub-phases of one and the same Pluvial. Whatever this may have been, it is quite clear that these pluvial episodes of the Tchad and its neighbouring region followed on some well marked Interpluvial, during which most of the fossil dunes of the Sudan were formed [2]. Unfortunately very little is known of what happened before that Interpluvial. It seems that

[1] For reference to the disputed problem of an ancient surface outlet and a present sub-terranean one through Wadi Bahr al-Ghazal (now dry) to the Depression of Eguidi (*Pays-Bas du Tchad;* some 100 m. below lake level) see F. Foureau (1905), t. I, p. 278; E. Gautier (1923), pp. 58-59; M. Abadie (1927), p. 78, and E. Antevs (1928), pp. 37-38. No detailed survey of the region is available and this question remains open. All that we know is that the Eguidi Depression has yielded sub-fossil fish bones of species similar to those of the Tchad (such as *Lapes*). See J. Pellegrin (1920), pp. 207-208. It is interesting to note, however, that the Bahr al-Ghazal cuts through some of the fossil dunes, which must therefore antedate it. See L. Aufrère (1930), p. 297. Another alternative explanation of the freshness of Lake Tchad (other than that which implies the existence of a former outlet) is the ingenious one suggested for some of the N. American closed lakes. It has been suggested that during a phase of desiccation (with only seasonal storms) the salt contents of the drying up lake would be deposited and gradually absorbed or sealed up by clays and other sediments. When the lake starts afresh, on the arrival of a new pluvial phase, its waters would be fresh, and usually remain so for a certain time. See reference in I. C. Russel (1885), p. 224; also in E. Nilsson (1931), p. 321 (where the theory is applied to some of the fresh lakes of E. Africa). It is possible that both processes of freshening "by desiccation" (at the time of the formation of the fossil dunes) and by "surface overflowing" (through an outlet during one or more of the expansion phases of the Tchad) were responsible for its being so fresh at the present time.

[2] Though of course some of the fossil dunes of the N. fringe of the Sudan Belt may have been formed at a later interval, e. g. the dunes formed immediatly before the last wet phase or sub-phase of Urvoy; see his work (1933), p. 507.

aeolian activity during this dry phase was so strong that it destroyed most of the former physiographic features of the country (especially in the Tchad Basin). By analogy with other parts of the Sahara, however, it appears that the (fossil) dunes were built up of sand and loose material which was brought into the Depression or carved out locally, by torrential activity during an earlier pluvial phase [1]. If this be so, the following may be suggested as the probable sequence of events in the W. Sudan during the Pluvial Period and later (starting with the most recent); (see olso Table XI below).

1) The historic phase with aridity and still moving dunes.

2) An earlier wet phase, very little marked and vaguely dated (probably corresponding to the "Neolithic" wet phase of the Sahara and the North or perhaps representing a last oscillation of the last Pluvial?). Thus far this phase appears to have been traced only in the region West of Tchad.

3) A phase with increasing aridity. Probable formation of some of the now fossil dunes in the Niger region.

4) A Pluvial phase (2nd Pluvial) with more than one maximum (probably three in the Lake Tchad region). In the lower part of the formations of this phase in the Jos Plateau (N. E. Central Nigeria) were discovered flint implements (quite rolled and slightly rolled) which may be roughly attributed to the late Lower and the Middle Palaeolithic [2].

5) A true Interpluvial with extensive fossil dune formations, especially in the Tchad Basin (also probably in the Senegal region, *vide supra*, p. 76). Volcanic activity was also strong in the Jos Plaeau.

6) An earlier, presumably long Pluvial, whose details are not known.

The E. Sudan and Erythrea.

In the E. Sudan the evidences of former climates have never been properly worked out. Hardly anything is known about the very recent (proto-historic) changes of climate in this crucial region. Furthermore, the destructive work

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[1] On the part played by running water in providing material for (subsequent) dune formation, *vide supra* footnote 4 on p. 76.

[2] See H. J. Braunholtz (1926), pp. 4-7.

of aeolian erosion on the one hand, and the immense coating by the Abyssinian mud (in certain parts), on the other, have made it difficult to trace the physiographic features of the Quaternary proper. It is sufficiently clear, however, that in spite of its thickness (reaching some 20 m. or more in places) the Abyssinian mud did not begin to accumulate over (certain parts of) the Sudan Plain until a comparatively recent geological date [1]. Concurrently with the deposition of this mud, water and surface erosion were probably active in the N. Sudan. Immediately below the Nile mud at Khartoum (at a depth of 18-20 m.) were discovered bones of *Elephas* sp., *Hippopotamus* sp., Antelope (*Tragelaphus*), Giraffe and a large Ox [2]. This fauna clearly indicates more abundant rainfall than at present. This rainfall must have continued on the Abyssino-Sudanese border at least during part of the period of mud accumulation, as otherwise it would be difficult to account for the wide-spread inundations of the Blue Nile and other Abyssinian rivers. According to observations made by Walther, this phase is to be distinguished from a presumably earlier one, which, in his view, represented the Pluvial Period *par excellence* [3]. During this period red laterites were formed all over the plains of the N. Sudan as far as al-Damir (lat. 18° N.) [4]. The fact that these laterites are now covered with a coating of detrital and weathered material (brown and black in colour) suggests that between their deposition and the

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[1] As we shall see in the Appendix at the end of present Part, the Abyssinian mud does not appear in Egypt until the close of Middle Palaeolithic times. Of course it may have begun to accumulate over the Djazirah (Gezira) Plain before it could finally find its way through Nubia to Egypt. It must have taken the Blue Nile some time to build up its present *levées* which prevent it from losing itself over the Sudan Plain as its tributaries the Rahad and the Dandar still do in the flood season.

[2] See J. Walther (1912), p. 297; also L. Joleaud (1933*c*), p. 602.

[3] See J. Walther (1912), pp. 295-298. It is interesting to note that this author who champions the school opposing the existence of a Pluvial Period in the Saharan arid Belt (*vide supra*, pp. 61-62), should admit the existence of such a Pluvial in the Sudan Plain.

[4] The formation of laterite is of course an indication of warm-wet and dry (or at least less wet) seasons alternating in each year. On conditions necessary for the formation of laterites see G. W. Robinson (1932), pp. 279-282; F. J. Richards, I. A. Cammiade and M. C. Burkitt (1932), pp. 195-196; also see work of R. Lang (1920), and reference in C. E. P. Brooks (1926), pp. 92-93.

establishment of the present dry conditions there must have intervened a long period (during part of which the original material forming the coating was laid down)[1]. Only in places where the present erosion has been able to weather off the coating are the laterites visible[2]. It would therefore seem that, taken as a whole, the Sudan Plain had two main pluvial phases during its recent geological history (Quaternary?). The latter of these was much less marked than the former, and its traces were largely obliterated or masked by concurrent and later deposition of Abyssinian mud. The first Pluvial, on the other hand, was longer and more important, though its rainfall was essentially seasonal (formation of laterites). The Interval between the two is not sufficiently clear as yet.

In the Erythrean territory the story of the Quaternary climates appears to be in general harmony with that of the rest of the Sudanese Belt. In the Basin of Danqala, on the Red Sea Coast, there are evidences of two distinct physiographic cycles[3]. The latter of these was apparently less pronounced than the former, and to it are ascribed three ill-defined terrace-levels which descend to some one hundred metres below sea-level. These levels appear to mark pauses in the decline of the so-called fluvio-lacustrine waters that filled the Basin. Before their formation a coral bank was built on the shore and now stands more or less about sea-level. As is the case in the E. Sudan, the earlier cycle corresponded to the real Pluvial Period (or major pluvial phase)[4]. It was also characterized by a succession of terraces which in certain parts of the E. side of the Basin stand at 30 metres, 120 metres, and 180 metres above sea-level (with higher levels on its W. side). Unfortunately our knowledge of the details of these two physiographic (and pluvial) phases and of the interval separating them remains incomplete.

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[1] There is little reason to think that the covering represents simply the (locally) weathered top of the laterites. In many places this covering is largely composed of material which had been carried over long distances by streams.

[2] J. Walther (1912), p. 298.

[3] See G. Stefanini (1930), pp. 160-161 and (1930*a*), pp. 25-30 and 39.

[4] G. Stefanini (1930*a*), p. 29.

The Abyssinian Plateau and Brit. E. Africa.

We may now proceed to a rapid consideration of Abyssinia and East Africa proper. It was at one time suggested by Hume and Craig[1] that during the Glacial Period the Asiatic centre of high pressure was very much stronger and the monsoons and semi-monsoons weaker than they are at present, so that Abyssinia was practically dry. This was interpreted by C.E.P. Brooks[2] as meaning that Abyssinia first received an abundant supply of rainfall during the equivalent of the Mindel-Riss Interglacial of the Alpine Belt. M. Awad has pointed out, however, that such an assumption would not harmonize with the existence of wide and deep valleys, which have been cut in some parts of the Abyssinian Plateau[3]. More recently, E. Nilsson has undertaken the investigation of the plateau and has discorvered lake-deposits, moraines, etc., suggesting climatic changes similar to those we shall presently see in British East Africa[4]. Briefly stated, the results of his investigations indicate the existence of two main Pluvials within Quaternary (including perhaps late Pliocene?) times. During the latter, and less marked one, of these Pluvials glaciation took place, for the first time, on the tops of some of the high mountains, and Lake Tana also first came into existence[5]. Nothing is known with certainty, however, about the details of this Pluvial. It was preceded by an Interpluvial during which great tilting took place and the E. and S.E. edge of the plateau (bordering on the Great Rift Valley) is estimated to have been lifted by some 1500 metres[6]. This was accompanied by volcanic activity which led to the blocking of the basin in which Lake Tana was

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[1] F. W. Hume and J. I. Craig (1911), p. 383.

[2] C. E. P. Brooks (1922), pp. 73 et seq.

[3] M. Awad (1930), pp. 273-274.

[4] E. Nilsson (1935), pp, 5-9 and 12-17 and (1938), pp. 426-429.

[5] It is thought that during the 1st Pluvial Abyssinian mountains (and even some of the E. African ones) were not high enough for glaciers to form. See E. Nilsson (1935), p. 16; also *vide infra*.

[6] E. Nilsson (1935), pp. 15-16. As a consequence of this, the surface of the plateau became inclined towards the W. and N. W.

formed later on [1]. These great earth movements and volcanic activity of the Interpluvial would be useful to bear in mind when we come to consider correlations with climatic changes in other parts of the world. The 1st Pluvial was much more important than the 2nd one. During it a wide area in the region where the Blue Nile makes its great bend was covered by an ancient lake (Lake Yaya) [2]. The deposits of that lake (reaching a thickness of some 80 metres) were covered (and protected) in places by a lava bed of 20 metres (belonging to the Interpluvial phase). It is not known whether the lake was drained by some tributary of what became, later on, the Blue Nile or whether it had its outlet towards the East [3]. At any rate, the above mentioned uplift and tilting of the eastern edge of the plateau must have helped to drain the lake completely (towards the West). The Blue Nile has then cut a ravine deeply across its ancient beds. The catchment area of Yaya was relatively limited in proportion to its maximum extension (7-8 times that of Lake Tana at present). It seems therefore necessary to assume that it existed during a major phase of pluviation. Unfortunately, however, nothing is known of the nature and details of this 1st Pluvial, or even of its exact date.

In E. Africa proper (British) more detailed information has come to light thanks to researches carried out there by Wayland, Leakey, Nilsson and others [4]. Sufficient material is now available on the past climates of that region which illustrates conditions along the Equatorial Belt proper. Although the evidence of the pluvial phases here (as on the Abyssinian Plateau) is largely based on

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[1] Lake Tana of the 2nd Pluvial had a higher level than that of the present day. For a map showing its former extension see E. Nilsson (1935), Fig. 4. Apparently, however, the River Abbai was able towards the end of that Pluvial to deepen its bed enough to drain the lake (perhaps completely?). Then in Post-Pluvial times fresh volcanic activity on a smaller scale caused a new damming up of the basin and the formation of the present Lake Tana. See E. Nilsson (1935), p. 9.

[2] See E. Nilsson (1935), pp. 6-7 and (1938), p. 429.

[3] This latter alternative is thought by E. Nilsson to be the more likely one; compare his works (1938), p. 429 and (1935), p. 16.

[4] See E. J. Wayland (1929), pp. 118-121 (1929*a*), pp. 132-134 (1929*c*), pp. 37-40 (1930), pp. 23-53 and (1931), pp. 385-386; L. S. B. Leakey (1931), pp. 6-17 (and Appendices in same work by J. D. Solomon, 1931, pp. 245-246 and 263-266, and C. E. P. Brooks, 1931, pp. 267-270) and (1934*b*), pp. 296-310, and E. Nilsson (1931), pp. 324-331 (1935), pp. 1-5, 9-12 and 17-20 and (1938), pp. 423-433.

"lake formation", which may not have always been controlled solely by climatic changes [1], the study of the extensions and contractions of the glaciers on some of the mountain blocks of the region has helped to check the number of the glacial-pluvial episodes [2]. The details of these episodes are now so clear and agreed upon that we need give only a tabular summary as below :

TABLE X.

Climatic changes in East Africa (Kenya) according to L. S. B. Leakey (1931) and E. Nilsson (1931 or 1932) (with whom E. J. Wayland's work in Uganda is in agreement). (The Table reads upwards and no time-scale is attempted.)

PHASES.	LEAKEY. CULTURES.	LEAKEY. CLIMATES.	NILSSON.
Post-Pluvial wet phases.	So-called Mesolithic and Neolithic Cultures.	..... / Nakuran wet phase.	Alternating wet and dry phases.
		Dry phase.	Arid sub-epoch.
		Makalian wet phase.	Wet sub-epoch.
		Dry phase.	Arid sub-epoch.
2nd Pluvial.	Mid. and Up. Palaeol. Cult.	Upper Gamblian Pluvial.	Wet sub-epoch.
		Mid. Gamblian phase.	Dry sub-epoch.
		L. Gamblian Pluvial.	Wet sub-epoch. / Dry — / Wet —
Interpluvial.	?	Long Interpluvial. Volcanic activity (and probably also uplift in places).	Arid epoch.
1st Pluvial.	L. Palaeolithic.	Kamasian Pluvial. Sub-divisions unknown.	Wet epoch. Sub-divisions unknown.

[1] On other factors controlling lake levels see C. Gillman (1933), (review in *G. R.*, pp. 674-675).

[2] See particularly E. Nilsson (1931), pp. 324-326. The synchronism of glacial and pluvial phenomena in E. Africa is not to be questioned.

From this summary we find that the last wet phase of Leakey (the Nakuran, which is incidentally dated by Leakey etc. at about 850 B. C.)[1] is simply regarded by Nilsson as one of the short spells of wet climate which still occur at the present day. On the remaining points there is close agreement between the two, except that the 2nd Pluvial of Nilsson had three sub-maxima (or at least the first of its two sub-maxima was more complicated than that of Leakey). Also Leakey appears to regard the Interpluvial as having lasted for a longer period than Nilsson admits[2].

During the Pluvial Period of E. Africa, or at least part of it, conditions must have been rather cool[3]. This is necessary to account not only for the extension of glaciers on the mountain-tops, but also for the spreading of species of cold flora and fauna (especially butterflies) between these mountains[4]. We are faced with the difficulty, however, that at least during part of the 1st Pluvial laterites were extensively formed in some of the local basins on the E. African Plateau[5]. This may have perhaps implied a high temperature during part of that Pluvial. The question of the exact temperature conditions during the pluvial phases of E. Africa must therefore remain unsettled.

Another point of interest which should also be referred to is the tectonic activity during the Interpluvial. According to recent investigations by L. S. B. Leakey, this was a phase of violent upheaval, to which he attributes

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[1] See C. E. P. Brooks (1931), p. 270.

[2] More recently, however, L. S. B. Leakey has discovered implements of Upper Palaeolithic appearance (of the so-called Kenya Aurignacian, usually placed at the beginning of the 2nd Pluvial) in formations belonging to the close of the Kamasian Pluvial (see reference in E. Nilsson, 1931, pp. 343-344). This would rather tend to cut down the length of the Interval. We need not, however, go here into controversies regarding the geological and archaeological validity of these and some of the other finds of Dr. Leakey in E. Africa. *Vide infra.*

[3] On cool conditions especially during the 2nd Pluvial see E. J. Wayland (1929*a*), p. 134.

[4] See A. Engler (1910), p. 989 (for flora) and Y. Sjostedt (1910), p. 57 (for fauna); also general references in E. Antevs (1928), p. 50. An interesting piece of evidence as to the severe conditions on the high plateau is that the L. Palaeolithic implements do not seem to occur above 6000 feet (see L. S. B. Leakey, 1934*b*, pp. 299-300). This may not necessarily mean that conditions on high altitudes were too severe for man, but it is probable that the most abundant game was on lower latitudes.

[5] See J. D. Solomon (1931), p. 261.

the formation of the Eastern Rift Valley as we know it to-day[1]. He estimates that the rifting was accompanied by an elevation of the Aberdare Ranges (within the Rift area) by some 4000 ft. Some geologists may be rather suspicious about such an elevation[2], though it is agreed that the Interpluvial and perhaps also part of the following Pluvial were characterized by vast physiographic changes[3]. Whatever this may have been, we prefer for the moment to accept the current view that, in its main outlines, the Great Rift Valley of East Africa antedates the Interpluvial, though it received certain modifications (very important in places) during that interval, or even at a later date.

Rhodesia and S. Africa.

Other investigations carried out in British Africa South of Kenya and Tanganyika have thus far yielded material comparable in part with that we have just reviewed, though there may still be certain points of difference regarding exact correlations. In Rhodesia and in S. Africa proper (Vaal River Basin) a sequence of climatic changes has been traced by various workers[4]. It would perhaps lead to unnecessary complications to go here into details of this sequence or into proposed correlations with episodes in E. Africa proper. It is unfortunate that we cannot rely much on archaeological data for working out such correlations. The Stone Age cultures of S. Africa (and Rhodesia) are not strictly comparable (in typology and technological evolution, *vide infra* Part II, Sections i and ii) with those of E. Africa, and consequently the formations and climates associated with them cannot be easily correlated with similar ones in E. Africa. It may be mentioned

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[1] L. S. B. Leakey (1934*b*), pp. 299-304.

[2] In a discussion following L. S. B. Leakey's paper (1934*b*, p. 307), C. W. Hobley makes the interesting remark that the Kamasian Lake which preceded the Interpluvial had an elongated shape which would suggest that it existed in some rift-like depression.

[3] On changes in Uganda (some time during the 2nd Pluvial) leading to the draining of Lakes Victoria and Kioga into the Nile (by way of Lake Albert) see E. F. Wayland (1929*a*), p. 134.

[4] For the Zambesi River see H. B. S. Cooke and J. D. Clark (1939), pp. 287-319, especially Table at end. For the Vaal River Basin see more detailed work by P. G. Söhnge, D. G. L. Visser and C. van Riet Lowe (1937), especially p. 50 and Table III.

in passing, however, that, in general outline, there is a fair agreement between the climatic episodes in the two areas. During Recent (Post-Pleistocene) times there existed oscillations similar to the Makalian and later phases or sub-phases of E. Africa [1]. Prior to that, in the Old and Middle Stone Age (*i. e.* Stellenbosch and Fauresmith cultures in S. Africa; together with Levalloisian and Stillbay industries—of the Middle Stone Age—in Rhodesia) there existed two so-called wet (or pluvial) phases, the earlier of which having two (or three?) sub-maxima [2]. C. van Riet Lowe has correlated these phases in S. Africa with the Gamblian and Kamasian Pluvials of E. Africa [3], but we rather prefer to consider them together as representing the equivalent of the Gamblian alone [4]. Before this Pluvial with its various sub-maxima there existed a particularly dry phase during which the so-called Kalahari Sands were deposited (by wind) [5]. This arid phase was again preceded by the Older Pluvial whose gravels in Rhodesia have yielded a very early Palaeolithic industry (seemingly Pre-Chellean) [6]. In S. Africa (Vaal River Basin), however, these gravels still remain undated [7].

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[1] C. van Riet Lowe (1937), Table III. These oscillations were associated in the Vaal River Basin with the so-called Middle Stone Age complex together with later (Final Palaeolithic and Neolithic) elements. In Rhodesia they were associated only with the latter elements.

[2] See P. G. Söhnge and D. G. L. Visser (1937), p. 50 and H. B. S. Cooke and J. D. Clark (1939), Table facing p. 317.

[3] See his work (1937), Table III.

[4] South Africa proper has always been a region of relative seclusion and survival of cultures, and we find no harm in equating its Old Stone Age (Stellenbosch and Fauresmith) with the 2nd Pluvial further North. The cultures of Rhodesia, and still more those of Kenya, were chronologically much ahead of those of the Vaal River Basin.

[5] These aeolian sands are generally supposed to be very early (*i. e.* equivalent of Pre-Kamasian); but, as already mentioned, this assumption is based on assigning early dates to the Old Stone Age cultures of S. Africa (*i. e.* considering the Stellenbosch to be *chronologically* the equivalent of the Chellean elsewhere). We prefer to place these sands in the main dry interval of the Pleistocene, *i. e.* the equivalent of the Interpluvial between the Kamasian and the Gamblian. On uncertainty of dating these sands see H. B. S. Cooke and J. D. Clark (1939), p. 307.

[6] See H. B. S. Cooke and J. D. Clark (1939), p. 307.

[7] See P. G. Söhnge and D. G. D. Visser (1937), p. 41.

S. W. Arabia (Yaman and Hadhramaut).

Another area whose climate is closely linked to that of E. Africa and which has recently been studied is S. W. Arabia (Yaman and Hadhramaut). In the summer of 1936 an expedition was sent by the Fuad I (Egyptian) University of Cairo to Yaman and Hadhramaut with the object of studying, among other things, certain aspects of the Quaternary and Recent physiography of that part of Arabia [1]. The material collected has not been studied in detail as yet, but in the main the following sequence of climatic changes may be drawn from it. In historic times there existed a wet phase which apparently continued well into the Christian era (perhaps to the 5th cent. A. D.) [2]. In the Pleistocene (including perhaps late Pliocene?) climatic changes more or less similar to those we have just seen from E. Africa have been traced. The expedition worked chiefly in those parts of valleys and basins which were sufficiently remote inland to be relatively independent, in their physiographic evolution, from changes in sea-level. An elevation of this latter would naturally lead to silting up in the lower courses of rivers (leading into the sea) and *vice versa*. Inland parts of streams, on the other hand, and also systems of internal drainage, were very largely governed, in their cycles of erosion and deposition, by climatic changes (affecting discharge etc.). Two series of deposits were noted in the primeval (Pre-Quaternary?) valleys and basins in areas relatively independant from changes in sea-level. The more recent one is made up of soft silts (in some cases loess-like or even semi-æolian) intercalated at places with (and replaced in the upper streams by) fine gravel. The maximum thickness of these silts reaches sometimes as many as 10 metres, though in a number of valleys they do not exceed 3 metres. In most valleys the silts and gravels are arranged in 2 or

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[1] On this expedition (undertaken by present writer and others) see S. A. Huzayyin (1936*a*), pp. 138-139 and (1937*a*), pp. 513-514. For further work in Hadhramaut see also G. Caton-Thompson and E. W. Gardner (1939), pp. 20-29.

[2] The existence of this wet phase has been deduced largely from archaeological data. See also S. A. Huzayyin (1935), pp. 19-23.

3 terraces rising above the present bed. These deposits must have been laid down during a phase of regular pluviation. At present they are being eroded away by irregular torrents which are cutting deeper the beds of valleys. Indeed these soft deposits may be taken to represent the last (2nd) Pluvial of the Pleistocene in this area [1]. It has not been possible to ascertain the oscillations of climate within this pluvial phase, but there is evidence from a few places to suggest either two or three sub-maxima within it [2]. This Pluvial was preceded by a phase of aridity during which irregular torrential activity (similar to that prevailing at present) led to the cutting of deep-sided valleys, *emboîtées* within older deposits [3]. This Interpluvial was characterized by the occurrence of extensive volcanic activity (accompanied by other tectonic features) especially in the N. E. parts of the Yaman Plateau. Extensive lava-flows were spread in valleys and basins, where they are now found covered with the fine (and semi-aeolian) silts of the succeeding Pluvial. These lavas recall the volcanic and tectonic movements of the Interpluvial on the other side of the Red Sea. It is also interesting to note that, almost invariably, these lavas form the covering of older and coarser gravels filling the primeval valleys and basins in N. E. Yaman [4]. These gravels were apparently deposited during an earlier and much more important Pluvial phase corresponding to the 1st or main Pluvial of Abyssinia and E. Africa. They rise to a height of 30 metres or more and are often arranged in a series of again 2 or 3 terraces [5]. Their coarse and rough character indicates more abundant rainfall than during the deposition of the silts of the 2nd cycle. Unfortunately nothing can be said with certainty as yet about the possible sub-maxima or even the exact date of this 1st Pluvial.

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[1] Their gravels yielded at a number of places flint flakes belonging to the Middle Palaeolithic phase, *i. e.* more or less the same cultural level as that of the 2nd Pluvial in the Saharan Belt and E. Africa.

[2] The last of these sub-maxima was apparently the least marked one.

[3] It was within these *emboîtées* valleys that the above mentioned silts and relatively fine gravels were deposited at a later stage (*i. e.* during the 2nd Pluvial).

[4] It was in these Older gravels that the new valleys *emboîtées* within the primeval ones were excavated by the irregular torrents of the Interpluvial (and the opening stages of the 2nd Pluvial?). The inner valleys are better developed at places where volcanic activity was less marked, *i. e.* where there was little or no volcanic covering to protect the Older gravels.

[5] These terraces appear to be mostly erosional, and their number varies according to places.

The Indian Peninsula.

We must now close our treatment of the Equatorial and Sub-Equatorial Belts by a brief reference to Peninsular India. We have already seen (*vide supra*, pp. 40-41) that during the Quaternary the Himalayas had a series of glacial episodes similar to that of the rest of the Alpine Belt. It has long been recognized, however, that the recent migration of cold species of plants and animals between the tops of the widely separated mountains and high hills in India and Assam must indicate at least one cold phase within recent geological times [1]. Apparently when the Himalayas were covered with ice, conditions over the Thar and the Indo-Gangetic Plain were wetter and cooler (at least during one phase) so as to allow the passage of such plants and animals [2]. But as is the case in E. Africa, we have to face the fact that in E. and S. E. India extensive laterite beds (demanding both high temperature and precipitation) were formed during the lower part of the Pluvial Period [3]. It is clear that relatively cooler conditions could not have existed right through Quaternary times.

Thanks to recent work especially by Cammiade and Richards, a succession of climatic changes has been established for the Quaternary of S. E. India [4]. In broad outline, the story may be summarized as follows (starting with the most recent):

(6) A Post-Pluvial phase of aridity (presumably associated with Final Palaeolithic and Mesolithic industries of unknown date but which may represent surviving facies?).

(5) A wet phase (or perhaps only a later sub-phase of No. 3?).

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[1] See G. E. Pilgrim (1910), pp. 441-442.

[2] In the Thar Desert there are extensive clay formations which indicate a recent pluvial phase or phases; see G. de P. Cotter (1923), pp. 205 and 209-210; also E. Antevs (1928), p. 41.

[3] See F. J. Richards, C. A. Cammiade and M. C. Burkitt (1932), pp. 195-196. Laterites now form on the Malabar Coast (where there is abundant monsoonal rainfall coupled with high temperature), but not on the E. Coast.

[4] See L. A. Cammiade (1931), pp. 370-371; L. A. Cammiade and M. C. Burkitt (1930), pp. 327-330; and F. J. Richards, L. A. Cammiade and M. B Burkitt (1932), pp. 193-205.

(4) A suggested dry phase or sub-phase.
(3) A pluvial phase with deposition of detrital laterites in pockets.
(2) A dry Interpluvial accompanied by erosion (probably accelerated by a rise in the land). (First appearance of man with advanced L. Palaeolithic cultures.)
(1) A long pluvial phase. Extensive formation of laterite (probably warm in part?).

Correlations along the Sudanese, Sub-Equatorial and Equatorial Belts.

From the summary indicated above it is clear that there is a remarkable correspondence between S. E. India and the rest of the Sub-Equatorial and Equatorial Belts. Indeed it may not by out of place, at the present stage of our knowledge, to attempt a general correlation of climatic changes along the whole of these Belts (including Sudan). This is done in tabular form as below (Table XI) and it remains only to add the following concluding remarks:

TABLE XI.

Tentative correlation of climatic changes along the Sudanese, Sub-Equatorial and Equatorial Belts (based on references mentioned in footnotes on pp. 113-127). (The Table reads upwards and no time-scale is attempted in it.)

PHASES.	W. SUDAN.	E. SUDAN.	E. AFRICA.	S. E. INDIA.
Post-Pluvial and Recent.	Modern dunes.	Dry.	Very recent wet and dry oscillations (including Nakuran).	Dry (perhaps with wet phase?).
	Slight wet phase.		Makalian wet phase.	
	Dry phase (some fossil dunes?).		Dry phase.	
2nd Pluvial.	Lake Tchad extension.	2nd Pluvial (beginning of deposition of Abyssinian mud).	Gamblian II.	Pluvial phase (perhaps interrupted?).
	Lake Tchad regression.		Drier phase.	
	Lake Tchad extension (double?).		Gamblian I (with two sub-maxima).	
Interpluvial.	Interpluvial. (Fossil dunes and volcanic activity).	Interval between two Pluvials.	Interpluvial. (Tectonic and volcanic activity.)	Interpluvial. (Slight landrise?).
1st Pluvial.	1st physiographic cycle.	Long Pluvial. (Laterites).	Kamasian Pluvial. (Laterites).	1st Pluvial. (Laterites).

a) Post-Pluvial oscillations have not yet been worked out in India, but it is interesting to note that in both E. and W. Africa there are traces of one or two Post-Pluvial wet phases. This will be of special help in the more general correlations we shall attempt later on.

b) During the Quaternary (including late Pliocene) there were only two pluvial phases—the first of which being by far the most important. In this respect the Sudanese, Sub-Equatorial and Equatorial zones agree with the Saharo-Arabian Belt and differ from European latitudes.

c) As is the case in some parts of the Saharo-Arabian Belt the 2nd Pluvial was characterized (at least in places) by two (or three) sub-maxima. The interval (or intervals) between these latter were not pronounced.

d) Only one real Interpluvial could be traced. It was accompanied by tectonic and volcanic activity.

e) Taken as a whole the pluvial phases may have been cooler than to-day; but at least during part of the 1st Pluvial this was probably not the case.

MISCELLANEOUS DATA RELATING TO PAST CLIMATES IN VARIOUS REGIONS.

North America. Its Last Ice Age.

We have now completed our regional treatment of the Quaternary climates of the main climatic zones of the Old World: the European, the Saharo-Arabian and the Equatorial (together with Sub-Equatorial and Sudanese). Before we attempt the final correlation of changes along these belts—(a correlation which will help to define, in particular, the place of the Pluvial episodes over the Saharo-Arabian area in the Quaternary succession)—it may be useful to mention, in passing, a few sporadic points from other parts of the world. In the N. Hemisphere, the question of American glaciations is a much discussed one. We know, however, that in Post-Glacial times, there was a definite phase of warmth corresponding to that of Europe (Climatic Optimum?)[1]. As on the coasts of Europe, it appears to have been accompanied by a northward spreading of warm types of sea-mollusca[2]. As to the climates of the Glacial Period proper there is no complete agreement between the various workers. Nevertheless, the following may be regarded as a representative standard view

[1] See W. A. Johnston (1933), p. 38. — [2] See C. E. P. Brooks (1922), p. 132.

of the succession of glacial and interglacial phases (starting with the most recent)[1]:

Wisconsin Glacial.

Peorian Interstadial or Interglacial.

Iowan Glacial (perhaps advance-phase of Wisconsin or late stadium of Illinoian?).

Sangamon Interglacial.

Illinoian Glacial.

Yarmouth Interglacial (probably very long).

Kansan Glacial.

Aftonian Interglacial.

Nebraskan or Jerseyan Glacial.

In the present state of our knowledge, no definite correlation with Europe would be safe, but it appears that the Yarmouth Interglacial at any rate corresponded in length (and nature) to the Mindel-Riss of Europe[2]. It is also possible, as Woldstedt points out, that the uncertain Iowan glaciation of N. America simply corresponded to the cold sub-phase which occured within the last Interglacial (Saale-Weichsel) of N. Europe[3]. If accepted, both these points would throw useful light on general correlations of Quaternary climates.

The S. Hemisphere. Data from Raised Beaches, etc.

A few interesting points are also available from the S. Hemisphere. Here as in the North, there is abundant evidence of a warm phase in Post-Glacial times, accompanied by a rise in the level and temperature of the waters of the Ocean. In S. America (S. Patagonia and Tierra del Fuego) raised beaches as high as 18 metres (but attributed to the Post-Glacial phase) have yielded relatively warm mollusca (now extinct or very rare in the locality), while favourable corners on the mainland still shelter plants of more northerly

[1] For a general statement of N. American glaciations as given here, see P. Woldstedt (1929), pp. 260-283. A different statement is given in W. A. Johnston (1933), pp. 11-32.

[2] C. E. P. Brooks (1926), pp. 277-278.

[3] P. Woldstedt (1929), p. 290. Or was it perhaps the equivalent of the Warthe stage?

(warmer) latitudes [1]. In S. Africa a very recent beach (presumably Post-Glacial) at 6 m. or 20 ft. above sea-level, contains shells of oysters (*Ostrea*) and other types now living only in the warmer waters of the S. E. coast (N. of Durban) [2]. It was probably laid down during a phase when the warm current of Mozambique gained strength at the expense of the southerly cold current (Benguela) and was apparently able to round the Cape of Good Hope. Similar recent (and warm) beaches occur also in S. Australia and New Zealand [3]. Even as far as the Antarctic this phase has left its mark. On the borders of this ice-ridden continent, sea-bottom sediments containing a small proportion of chalk thinly cover another layer with more chalk. At present the chalky sediments are best developed outside the pack-ice area, and E. Philippi has drawn the conclusion that in Post-Glacial times the pack-ice was more limited to the South, and chalk was formed more freely [4]. Raised beaches at a height of some 18-55 metres have also been found in many places in Antarctica, and they contain mollusca, some of which no longer living south of the Sub-Antarctic islands [5]. It is not clear, however, whether these refer to the Post-Glacial warm phase or to some earlier one. Indications of such an earlier phase are not lacking from the S. Hemisphere. In S. Australia (and New Zealand and Tasmania), there are evidences of a warm interglacial phase separating two glacial episodes (the latter of which having two sub-maxima) [6]. Also in S. Africa there is a high beach (30 m.) on the S. W. Coast (N. of the Cape) and which yielded *Ostrea* and other members of a warm fauna of the Mozambique current [7]. Unfortunately the

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[1] See C. E. P. Brooks (1922), pp. 132-133.

[2] See A. V. Krige (1926), pp. 43-44 and 69-73, and (1928), p. 123; also reference in S. H. Haughton (1929), p. 40.

[3] See C. E. P. Brooks (1922), p. 133.

[4] E. Philippi (1910), p. 458.

[5] C. E. P. Brooks (1922), p. 133.

[6] See P. Woldstedt (1929), p. 286-287. It is suggested that the three glacial episodes corresponded to the Würm, Riss and Mindel stages of the Alps; see E. Antevs (1928), p. 44. Although the problem of correlations has not yet been sufficiently worked out, it is further interesting to note that, as in the N. Hemisphere, the Glacial Period was heralded by a phase of gradual cooling.

[7] See P. A. Wagner and H. Merensky (1929), pp. 12 and 14-19; and S. H. Haughton (1929), pp. 36-38. Among the species discovered in the so-called Oyster-line (75-110 ft.) are : *Ostrea*

age of this beach is not clear. It has been suggested that, by analogy of some of its faunal members with other fossil mollusca of S. Africa, the beach may be as old as the Mio-Pliocene; but it is equally probable that it corresponded to one of the Quaternary immersion phases of the southern coasts [1]. If this latter assumption be accepted, there would be every reason to correlate this 30 metres beach with its equivalent in the Mediterranean Basin (Tyrrhenian level 30 m.) and which (as we have already seen, *vide supra*, p. 49), indicates a northward spreading of Sub-Equatorial types of mollusca. Indeed there is reason to assume that, taken in its broad outline, the evidence from the S. Hemisphere agrees with that from the N. Hemisphere. In lands where no glaciations have as yet been traced (such as S. Africa) pluvial episodes appear to have taken place in a succession more or less similar to what has been discussed for regions north of the Equator.

THE PROBLEM OF THE GENERAL CORRELATION OF PAST CLIMATES ALONG VARIOUS LATITUDES IN THE OLD WORLD.

"Primary" and "Secondary" Factors involved in Climatic Changes. Present Day Conditions and the Study of Past Oscillations.

Turning now to the final correlations of the changes along the various climatic belts, we find ourselves confronted with the paramount difficulty of finding an explanation for these changes in the light of the multitude of theories (cosmic, astronomical, geological, etc.), which have been put forward [2]. It would serve no practical purpose, however, to attempt a general survey of these various, and often conflicting, theories, none of which appears to be capable alone of explaining the climatic oscillations of the geological

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prismatica, Chamelea Krigei, Donax Rogersi, Lamina, sp., *Isurus* sp., etc. Another level at 18 m. contains a banal fauna.

[1] See S. H. Haughton (1929), p. 40; and P. A. Wagner and H. Merensky (1929), p. 12. On submergence phenomena in the recent geological history of the coast of S. Africa, see A. V. Krige (1926), pp. 19-24 and 72-73.

[2] On such theories see general statements by G. F. Wright (1911), pp. 495-531; P. Woldstedt (1929), pp. 348-363, and various chapters in C. E. P. Brooks (1926).

past[1]. Such a study would require a special treatment on its own, for which we do not feel qualified. Suffice it therefore to state that the problem as to "primary" causes of the climatic changes in the past remains a puzzle, and that the solution might perhaps best be sought in a combination of more than one theory. A more practical and illuminating line of inquiry for us to follow, however, would be the studying of the probable "meteorological" factors at work during a Glacial Period. This gives what may be termed as the "secondary" causes of (or rather the "secondary" factors involved in) many of the climatic changes of such a period[2]. In spite of slight differences of opinion between various workers, it appears that both a decrease in the temperature and an increase in the precipitation have played their respective parts in the production of glacial and pluvial episodes[3]. It may be stated, by way of generalization, that while in the areas with glaciations, especially in the N. latitudes, a decrease in the summer temperature may have been the most important factor in the extensions of the ice-sheets, a rise in the temperature, evaporation and precipitation may have been even more particularly favourable for the production of pluvial conditions in lower (especially Equatorial) latitudes. A clear elucidation of the parts played by each of these two factors can perhaps be best approached through comparison with present day

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[1] One recent theory which deserves mention, however (as it touches upon the main line of argument pursued in the following paragraphs), is that of G. C. Simpson (see his works 1929, pp. 23-33; 1930, pp. 262-268 and 1934, pp. 425-446 and 464-468). He starts by assuming that the climatic changes were caused by changes in solar radiation. From this he finds reason to think that there must have been four glacial phases and three interglacial ones in the last Ice Age (*i. e.* as in the Alps). But he also believes—and this is the main part of his theory—that the last and the first of the three Interglacials (*i. e.* R.-W. and G.-M.) were warm and wet, while the middle one (M.-R.) was cold and dry. As we have seen, however, such an assumption is largely at variance with the geological and morphological data.

[2] As distinct from the "primary" or "initial" causes of the Glacial Age.

[3] See J. Walther (1908), p. 498; Ed. Brückner (1910), pp. 106-108; A. Penck (1914), p. 292; and E. Antevs (1928), p. 55 (also H. Louis 1938, p. 284). Of these authors the first regards an increase in precipitation as being more important than a decrease in temperature in the production of *glacial* episodes, while all others are in favour of an opposite view. It is generally agreed that the total drop in the temperature during a glacial phase was about 3° or 4° C. Only part of this could be attributed to the annual melting of ice (which required heat), and the remainder must represent a net drop in the mean temperature (especially in summer).

conditions. In this respect we may note the occurrence of special years of abnormal climatic conditions, such as years of exceptionally cold winters or ones of exceptionally warm and long summers in Europe. The study of these abnormalities would throw useful light upon the tangled problem of past oscillations. Data available on such abnormal years, however, are still relatively scanty, and we must remain content, for the moment, with making comparisons and contrasts with normal conditions. At present, the climate may be regarded as resembling (in a broad way) an interglacial-interpluvial phase[1]. The northern part of Europe receives its precipitation through westerly winds and storms advancing from the N. Atlantic. During the warm months of the summer exceptionally low pressure conditions prevail over C. Eurasia and the winds and rains are drawn far into the heart of Asia. In the winter, on the other hand, the Arctic Anticyclone becomes more extensive, and it either shuts some of the westerlies off, or slightly diverts them southwards. In this latter case the Alps and S. Europe receive more precipitation (both solid and otherwise). In the Mediterranean, the rainfall is entirely seasonal. Winter rains are caused by westerly Depressions (of pressure) which are either introduced from the Atlantic or evolved locally over Mediterranean waters. At the present day, a number of these Depressions reach as far as N. W. India. The rainfall over the northern stretches of the Saharo-Arabian Belt is closely connected with that of the Mediterranean. It is derived from the westerly Depressions, and on the whole it diminishes from W. to East. The wind system over this belt is also interesting. In the summer months the northerly trade winds (called Harmattan in the W. section) are comparatively weak, though they continue to blow incessantly especially over the E. section. In the winter, on the other hand, these winds are rather violent and they reach well into the Sudan Belt. A stream of them (the so-called Egyptian Air Stream) penetrates over the E. Sudan to the Equator and even reaches as far as lat. 20° S.[2]. During short intervals,

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[1] For a general description of present day climatic conditions over various parts of the Old World see W. G. Kendrew (1927) or (1937) especially Parts ii, iii and iv on the Continents of Africa, Asia and Europe.

[2] On this air stream see C. E. P. Brooks and S. T. A. Mirrlees (1932*a*), p. 10 and Fig. 5.

however, the eastward penetration of Depressions along the Mediterranean weakens these winds, as it cuts them from their roots further north [1].

To the S. of the Sahara, the rainfall is essentially seasonal. The monsoons are particularly powerful in the summer, when their effect is felt as far north as the Massifs of the C. Sahara. Along the Saharo-Sudanese transition zone precipitation takes the form of tornado storms which occur as a result of the meeting of the monsoons with the Harmattan currents [2]. In the E. Sudan conditions are somewhat more complicated. According to M. H. Muhammad the rainfall of the Sudan Plain appears to be partly connected with the meeting of two air currents of unequal temperatures; the one from the Indian Ocean (warm) and the other from the S. Atlantic (relatively cooler) [3]. This is particularly significant as it shows the change which might have taken place if the cool Egyptian air stream (mentioned above) were stronger in summer than it is to-day. It is interesting to note that at the present day, a good deal of the moisture and clouds driven from the south are simply dissipated in the warm dry air on their arrival at the edge of the true Desert Belt in the northern Sudan. This may be largely attributed to the relative lack of cool wave-fronts arriving from the North. In the extreme East of the Sudan (Erythrea) the northerly and north-easterly winter winds pass over the Red Sea and bring rain to its western coasts [4].

Along the Equatorial Belt proper the rainfall is of course distributed all the year round. It is largely of a convectional character; but in some regions as E. Africa the régime is further complicated by the existence of the semi-monsoons. In India the true monsoons prevail.

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[1] This is particularly clear in the spring and early summer, when the passage of pressure-Depressions nearer the S. coasts of the Mediterranean causes such local winds as the Khamseen and the Sirocco, which blow in directions different from those of the northerly trade winds.

[2] Usually the relatively cooler and weaker Harmattan winds penetrate along the upper layers of the air, while the warm monsoons push their way at lower altitudes. Then the latter winds attempt to rise up and break through the Harmattan cover, which produces the tornadoes.

[3] See M. H. Muhammad (1929), pp. 44-45. In the opinion of this author the difference in the temperature of the two air streams may be attributed to the effect of the warm currents of the Indo-Arabian Ocean on the one hand, and the Benguela current on the other.

[4] On the rainfall of Erythrea see the work of F. Eredia (1932). (Also review of the same in *G. J.*, vol. LXXXII, No. 1. July 1933, p. 91.

Meteorological Changes during Glacial and Interglacial Phases.

Let us now visualize the probable changes which might take place in this normal climatological régime : first during a glacial phase and then during an interglacial one [1].

Starting with Europe we find that a decrease in the temperature leads to an increase in "solid" precipitation and an extension of snow-fields. This would be felt not only in the northern parts of the Continent, but also over the Alpine Chains, where a drop in the temperature would lower the permanent snow-line and decrease the melting in spring and summer. At first, the westerlies would continue to penetrate eastwards; but gradually the extension of ice-sheets over the interior of the Continent would hamper their course. Eventually the cold continental north-easterlies would gain in force and sweep over the N. W. fringes of the Continent, though in some places the equable effect of the Ocean and the Gulf Stream might still be felt [2]. As a glacial phase more or less definitely established itself over N. and C. Europe the main body of the westerlies would be forced to follow a more southerly course. In this case S. Europe, the Mediterranean and the N. Saharan Belt would receive more and more rainfall [3]. It is probable, however, that the southward

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[1] The main arguments which will be outlined in the following paragraphs have already been published in summary form by the present writer in (1936), pp. 20-22.

[2] In some cases, however, the glacial phases were accompanied by cold seas in N. W. Europe, as is illustrated by the southward expansion of boreal mollusca. In such cases, of course, the effect of the Gulf Stream would be limited.

[3] E. Antevs (1928, p. 32; also reference in P. Woldstedt, 1929, pp, 284-285) makes the interesting suggestion that the Glacials of N. and C. Europe were probably slightly earlier in their occurrence than the Pluvials of lower latitudes. More recently C. Johns (1934*c*, pp. 417-422) has suggested that a Glacial in N. Europe would correspond to an Interglacial in the Alps (which lie in the anticyclonic area of the N. glaciation) and a Pluvial in the N. Sahara. This author, however, does not give any evidence in support of his view, which would rather assume that the development of the ice sheets over Scandinavia and the N. Plain of Europe was so quick that it did not give the high mountains of the Alps a chance to develop their glaciers before they were incorporated within the anticyclonic zone of the North. Nobody would seem to accept this. We may mention, however, that it is quite probable that in certain parts of the N. Mediterranean the maximum of pluviation did not actually coïncide with the maximum of glaciation over the Alps—which was a period of anticyclonic activity immediately to the S. of these mountains.

diversion of the westerlies would be less in summer than in winter and that the N. Sahara would still have one dry (or semi-arid) season. Also the extent of the penetration of the westerly Depressions eastwards (along the Mediterranean) could not be definitely fixed, though it is probable (on the evidence of a Pluvial Period in Iran) that they could reach as far as the confines of India[1]. But the frequency of these latter Depressions would presumably have a more far-reaching effect than might at first seem. They would cut the northerly trade winds from their root in the centre of high pressure over inner Eurasia. As the westerly storms would certainly be more frequent in the W. Mediterranean than further East, they would especially weaken the Harmattan of the W. Sahara. The result would be an increase in the penetrating power of the southerly monsoons which could in that case reach the Central Massifs of the W. Sahara more frequently than they do to-day[2]. The E. Sahara, on the other hand, would remain comparatively dry. It should be noted, however, that as a result of the relative power of the trade winds in this region during the summer months (when the westerly Depressions are rare), the monsoons of the N. Sudan would be confronted with an increasing

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[1] If we adopt this view, however, it should be assumed that although during a glacial phase conditions may have been severe over the Iranian Plateau, the isolated ice-caps over its high mountains were never strong enough to form a continuous belt of high pressure that would completely shut off the westerly Depressions. But it is equally probable that the existence of more extensive water sheets in S. W. Asia during the Quaternary (the Persian Gulf and L. Mesopotamia on the one hand, and the Aralo-Caspian and Pontic Basins—receiving run-off of melting ice sheets of Russia—on the other) might have had a marked effect upon the local rainfall of this region.

[2] We should note here, however, the suggestion made some time ago by A. Penck (1914, pp. 286-293; also his work 1913, pp. 77-97), that during a cold phase (Glacial in Europe) there is a wholesale shift (by 4-5°) of all climatic zones towards the South (producing what he calls *kataklimatische Bewegung*). The opposite (*anaklimatische Bewegung*) takes place during an interglacial phase. This means that at times when the N. of the Sahara would be enjoying pluviation its southern border would not only remain dry but would even encroach upon the Sudanese zone. We have seen, however, (*vide supra* especially footnote 2 on p. 72 and corresponding text) that the evidence from the Sahara (especially that relating to the water-fauna) is decidedly against such an assumption. It is practically certain that pluviation took place simultaneously on both borders of the Sahara. It is interesting that the suggestion of Penck has also been proved by Fr. Jaeger (1926, pp. 61-62) to be inapplicable to the Sub-Tropical border of the Mexican Plateau.

number of cool-wave fronts, and thus precipitate their content of moisture instead of losing it in the air as they frequently do to-day.

Along the Sub-Equatorial and Equatorial Belts a slight decrease in the temperature might mean a relative weakening of the monsoons and similar winds, but it would also lead to a decrease in the evaporation on the land. The "effective" value of the rainfall (in forming lakes, etc.) would not therefore suffer much. It is also probable that the disturbance which takes place in the circulation system of the world as a whole, might lead to a slight increase in storminess along the Equatorial Belt. It is quite possible, for example, that the so-called Egyptian stream of cool air which does not now penetrate south of lat. 20° N. during the summer[1] (though it reaches 20° S. in winter), was more powerful during the summers of a cold phase. This would mean that Abyssinia, the S. Sudan and parts of Equatorial E. C. Africa would receive more frequent cool-wave fronts, which instigate storminess and thus increase precipitation. The advance of such northerly cool waves along relatively high altitudes may have also been partly responsible for the development of snow-fields and ice-caps on some of the mountain blocks of E. Africa.

And finally in India the formation of glaciers over the Himalayan border must have a marked effect upon the precipitation over the rest of the Peninsula. Storminess along the region of contact between the southerly monsoons and the cold front of the North would lead to an increase in the precipitation over the Indo-Gangetic Plain. As the total decrease in the temperature during a glacial phase does not usually exceed 3°-4° C. (*vide supra,* footnote 3, on p. 134) it would be out of the question to think that the monsoons would be shut off altogether. It is possible, however, that they would suffer a slight deflection from their present course. One would expect their northern end to be bent south-eastwards and eastwards; and in that case the E. side of the Peninsula would presumably get more rainfall than under present conditions. Furthermore, the winter monsoons of the Bengal Bay would almost certainly gain in force and bring more rainfall to S. E. India.

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[1] On present extent of this stream in summer see C. E. P. Brooks and S. T. A. Mirrlees (1932*a*), p. 13 and Fig. 13.

The meteorological changes which would take place during an interglacial phase are, however, rather more complicated than those which characterize a glacial phase. We have seen that in N. latitudes intervals between Glacials were either warmer or cooler than at present. The factors involved in changes during a *warm* Interglacial (or part of an Interglacial) may be visualized as follows : A rise in temperature generally means an increase in the evaporation over the oceans; and this must ultimately take the form of precipitation over some region or other of the world. The evaporation is particularly increased if the phase is also marked by a rise in the temperature of the waters of the seas (as may be testified, *e. g.* by the spread of warm malacological fauna northwards and southwards from the Equator). It seems that during such warm intervals there is also an all-round acceleration in the circulation system over the whole Earth. Moisture-bearing currents penetrate far into the continents. Regions which now have a stormy climate would presumably get more frequent and more violent storms. It is known that an increase in the amount of moisture available in the air would mean an increase in its latent heat and a development of storms and cyclones. Furthermore the courses followed by these storms would be less defined (owing *e. g.* to the limitation of the cold anticyclonic fronts which force them to proceed along certain lines). Over N. and C. Eurasia, we should expect a wider dispersal of storms, while, in the Mediterranean region and the N. Sahara, the number of Depressions which "stray" southwards may be increased. This would particularly be the case if such inland-seas as the Mediterranean had warmer waters, as in this case there would be more local evaporation and presumably also more local Depressions (of the type now formed over the Mediterranean itself). The intensification of the low-pressure trough over the C. and E. Sahara and S. W. Asia generally, could not fail to attract some of these storms (especially in the spring and autumn seasons).

In the Equatorial and Sub-Equatorial Belts the monsoons and semi-monsoons would be particularly strong and lasting. In regions like Sub-Equatorial Africa they would have a wider range of penetration. Those of the Gulf of Guinea, would acquire strength to reach the remote centre of the Sahara, while those of the Indo-Arabian Ocean would bring more rainfall to Abyssinia and the Sudan Plains, as well as to S. and C. Arabia.

In India a similar phenomenon would take place. At the same time an increase in temperature would lead to an acceleration of the upward movement of air over the Equatorial Belt as a whole, which in turn must lead to an increase in convectional rainfall. In this way the same amount of water could be dropped as rain for a larger average number of times (within a given period) than to-day. Such a particularly "warm-wet" phase would be ideal for the formation of laterites and similar deposits[1], which are so extensively found in Equatorial and Sub-Equatorial zones (where they are now limited to certain favourable areas).

Meteorological conditions prevailing during a *cool* Interglacial (or part of an Interglacial) are different from those we have just outlined. They are different from those of either a Glacial proper or a *warm* Interglacial. With a temperature only very slightly cooler than at present, there would probably be a general relaxing in the aerial circulation over the globe as a whole. Conditions over N. latitudes would not be cold enough (especially in the summer season) to allow the development of snow-fields and ice-sheets, and there would therefore be little or no diversion of the Westerlies southwards. In Lower latitudes such winds as the monsoons and semi-monsoons would be weaker, and seasonal rainfall much reduced. Convectional rainfall over the Equatorial Belt would also become less abundant. This is the type of phase during which one would expect *interpluvial* conditions over Middle and Equatorial latitudes.

Three main points crop out of the above argument and may be summarized as follows :

(1) The formation of ice-sheets and caps in the N. would lead to an acceleration in the pressure-gradient practically all over the world (thus increasing precipitation by more frequent contact between cold and warm air-fronts). There would be also a gradual shift southwards of the stormy belts of Mid-Northern latitudes. A Glacial in the North would therefore correspond to a Pluvial in more southerly (Middle and Equatorial) latitudes.

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[1] *Vide supra* footnote 4 on p. 117. It is clear that even during this phase there would be a relatively dry (*i. e.* less monsoonal) season.

(2) If an Interglacial in the North is relatively warm (warmer than at present) pluvial conditions would prevail in N., Mid. and Equatorial latitudes. This would be particularly the case if the rise in air-temperature were accompanied by a rise in the temperature of the seas. The latter would increase evaporation generally (and thus provide more material for ultimate precipitation). Monsoons (and semi-monsoons) would be stronger, and storminess more wide-spread. The tracts for the storms would be rendered less definite and remote continental regions would be reached by air currents.

(3) If, on the other hand, the Interglacial in the North were relatively cool (very slightly cooler than at present) it would correspond with dry conditions in Middle and Equatorial (including Sudanese) latitudes. There would probably be, as indicated above, a general relaxation in air circulation and perhaps also in the precipitation resulting from contact of warm and cold fronts. The drop in temperature would not be enough for the formation of ice-caps (and sheets) and the acceleration of pressure-gradient leading to such climatological disturbances as may take place during a Glacial proper. Conditions would be more or less similar to (or even drier than) those prevailing at present.

TENTATIVE GENERAL CORRELATION OF GLACIAL AND PLUVIAL EPISODES IN THE OLD WORLD DURING QUATERNARY AND RECENT TIMES.

And now we must turn to the Ice Age and see in what measure could its cold and warm episodes be interpreted on the meteorological principles outlined above. This leads us to the final correlation of these changes which may be set forward in tabular form as below (Table XII). It remains necessary, however, to add the following explanatory remarks on each of the climatic phases included in the Table (starting with the most recent):

(1) The last wet phase that concerns us here is the one which coïncided with the Climatic Optimum (*sensu lato*) of Europe. This was a phase of increase in temperature not only on the land but also in the waters of the sea. Warmer mollusca spread northwards along the

shores of N. W. Europe, and a similar movement also took place in the S. Hemisphere, especially in S. Africa (20 ft. beach). We may suppose that during this "Post-Glacial warm phase" there was an increase in the evaporation and general precipitation over the world. Storms, usually confined to definite courses could then reach such remote regions as the C. Sahara. We correlate this episode with the so-called "Neolithic" wet phase of the Saharo-Arabian Belt[1].

(2) Prior to that there was a phase of gradual desiccation. It coïncided partly with the final stages of the Late-Glacial phase of Europe. The ice-sheets and caps were shrinking, but temperature was not yet high enough to stimulate evaporation and precipitation over Middle and Lower latitudes. In the Sahara this dry phase corresponded to the Final Palaeolithic industry.

(3) The preceding phase was a longer and more complicated one. It corresponded to the Late-Glacial (Bühl, etc.) phase and the last glaciation (Würm) of Europe. Between these latter two phases there was an interval (Achen) which did not amount to an Interglacial proper. A much less definite interval also appears to have existed between the two sub-stages of the last glaciation (Würm I and Würm II, and their equivalents in N. Europe?). Meteorological conditions prevailing during this phase as a whole were those of a particularly cold régime (outlined above). It is therefore correlated with the Second Pluvial of both Middle and Lower Latitudes[2]. The two (or three) sub-maxima which this Pluvial exhibits in certain places correspond to the two (or three) aforementioned sub-phases of glaciation in Europe.

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[1] The term "Neolithic" is here used in its widest sense. It is interesting, however, to note that the approximate dates fixed on separate grounds for the Climatic Optimum and the "Neolithic" wet phase in Egypt show a remarkable degree of correspondence (compare *supra* Table III and p. 94).

[2] It is also interesting to note that, as in Europe, this Pluvial is associated (in a general way) with Middle and Upper Palaeolithic cultures both in the Sahara and the Equatorial areas.

TABLE XII.

Tentative general correlation of climatic changes over the Old World. (Compare with Tables II-XI.). The Table reads upwards and no time-scale is attempted in it.

N. LATITUDES.		MEDITERRANEAN.	SAHARO-ARABIAN BELT.	EQUATORIAL BELT (E. AFRICA).	GEOL. PHASES IN MID. AND EQUAT. LATITUDES.
N. EUROPE.	ALPINE BELT.				
Post Climatic Optimum (cooler).	?	Desiccation with minor oscillations.	Desiccation with minor oscillations.	Very recent oscillations (including Nakuran).	Recent.
Climatic Optimum.	Warm phase.	Presumably warm-wet phase? (Slight elevation of water level?)	"Neolithic" warm (?)-wet.	Makalian wet phase.	
Transition (starting towards close of Late-Glacial).	?	Gradual desiccation.	Desert conditions (already starting towards close of 2nd Pluvial. (Dune formations?).	Dry phase.	Late or Post Diluvium (Transition).
Late-Glacial stadia.	Late-Glacial stadia (including Bühl).	Post-Monastirian regression. A pluvial phase with succession of wet and dry sub-phases.	2nd Pluvial (with two or three sub-maxima). Partly cool.	Gamblian II.	Up. Diluvium.
Daniglacial Retreat (?)	Achen Retreat.			Relatively drier interval.	
Weichsel (with Warthe?).	Würm I and II.			Gamblian I (two sub-phases).	
Saale-Weichsel Interglacial (first warm, then cool and then warm again).	Riss-Würm Interglacial.	Monastirian transgression. Presumably dry interval with volcanic activity on land.	Interpluvial. Dunes and other æolian formations. Also volcanic activity.	Interpluvial with volcanic activity.	Mid. Diluvium.
Saale (with Warthe?).	Riss.	Regression of sea. Presumably cool and wet.	1st Pluvial (presumably first relatively cool, then warm and then relatively cool again). Major physiographic phase.	Kamasian Pluvial (presumably first relatively cool, then warm and then relatively cool again). Major physiographic phase.	L. Diluvium.
Elster-Saale Interglacial.	Mindel-Riss Interglacial.	Tyrrhenian transgression (very warm waters). Presumably warm-wet. (Erosion in Italy helped by elevation?)			
Elster.	Mindel.	Regression of sea. Presumably cool and wet.			
Pre-Glacial.	Günz-Mindel Interglacial.	Milazzian and Sicilian phases. Cold (and cold waters).	Pre-Pluvial phase. Gradual oncoming of relatively cool and wet conditions.	Pre-Pluvial phase.	Pre-Diluvium.
	Günz.				

(4) The Riss-Würm Interglacial of Europe did not represent a continuous warm phase. As we have already seen, it was interrupted by a cool dry sub-phase. Taken as a whole, its climatic régime could therefore have been neither of a continuously cold nor of a continuously warm character. Perhaps it resembled the present régime (or was even less stormy?). This Interglacial may not have been very long, but it appears that at least its middle part represented one of the driest (if not the driest) intervals in the climate of the world within recent geological times. It is correlated with the only "Interpluvial" traceable in the Diluvium of the Saharan and Equatorial zones. It is also interesting to note that this phase was marked by almost world-wide crust and volcanic disturbances.

(5) Prior to that there was a very much longer and still more complicated phase. It is quite possible that it covered a period several times as long as all the posterior phases put together. In Europe it had three distinct sections: *a*) Riss, *b*) Mindel-Riss and *c*) Mindel (and their equivalents in the North). During the Riss and the Mindel glaciations the meteorological régime was of an exceptionally cold character (as outlined above). In the Mindel-Riss Interglacial, on the other hand, it must have been of the opposite type (exceptionally warm). We have already seen that in C. Europe and the extreme N. of Eurasia this interval was at least warm-temperate (if not warm in the former), and that it was not interrupted by any cool episodes. We have also put forward the evidence on which we attribute to the same Interglacial the Tyrrhenian (30 metres with *Strombus*) beach of the Mediterranean (and probably also the 30 metres one (with *Ostrea*) of S. Africa?). It is almost certain that this phase was marked by warm seas at least in L. and Mid. latitudes[1].

[1] This is testified by the northward migration of warm malacological fauna. It is not known, however, whether the northern seas of Europe (N. Sea and Baltic) have received any relatively warm fauna during this Interglacial (see reference to controversy in W. B. Wright 1937, pp. 143-147). But it should be made clear that the northward spreading of warm sea-mollusca along the coasts of extreme N. W. Europe (Baltic and Scandinavia) was not only governed by the rise in the water-temperature but also by physiographic changes in the relations of land and sea (*e. g.* the

Its meteorological régime must have therefore been one of exceptional warmth on land and in sea (outlined above). The pluviation which started in Saharan and Equatorial latitudes during the equivalent of the Mindel glaciation continued during the equivalent of the Mindel-Riss and linked up with that of the Riss. At the moments of transition between the three sub-phases (*i.e.* at the very beginning of the Mindel-Riss interval and towards its close) there may have been relatively drier conditions in these latitudes; but, at any rate, the transition appears to have been rather imperceptible (compare our Diag. 6 on Pl. V).

(6) And finally the earliest phase was that termed as the Pre-Glacial in Europe. It included the Günz-Mindel and the Günz of Alps. In N. Europe it was heralded by a phase of gradual cooling (*refroidissement*), though at its end (*i. e.* during the Pre-Elster interval) conditions became quite temperate. It is not known what exactly took place in Middle latitudes; but it seems that it was also a phase of gradual cooling (as shown by the Mediterranean mollusca etc.). There is good reason to think, on the other hand, that as glaciation was not sufficiently developed over Europe, and the main body of the westerlies not generally diverted southwards, the Sahara passed through a stage of progressively increasing rainfall, but did not enjoy pluviation in the full sense. Apparently also the 1st Pluvial (*sensu stricto*) of the Equatorial zone was preceded by a transitional phase of steadily increasing pluviation.

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closing of the English Channel). As we have already seen (*vide supra*, p. 22), the Elster was primarily a "mountain glaciation" while the Saale extended more freely on the N. W. fringes of the European Plain, and probably represented the maximum glaciation in England (also *vide supra*, pp. 16-17). So it may be safely assumed that the recovery of the land of the N. Sea (or part of it) and the English Channel immediately after the Elster was easier and quicker than after the Saale (which pressed harder on the land). The probable result of this was that the rate of the rise of the land in the Elster-Saale Interglacial was quicker than that of the rise of the sea (as a result of the melting of the ice); so that the English Channel may have remained closed.

Addendum on Geological Nomenclature.

Before we close the present Part a note must be added on the geological nomenclature. There has so far been no agreement amongst workers in Quaternary geology on the exact connotation of the terms Pleistocene, Plio-Pleistocene or Upper Pliocene. The term Quaternary is given a wider sense and is used whenever vagueness of date is recommended. The origin of the difficulty lies in the fact that it is practically impossible to draw any faunistic divide between the Up. Pliocene and the L. Pleistocene or within the Pleistocene itself[1]. Indeed, from this point of view the Up. Pliocene is apparently more closely associated to the L. Pleistocene than to the L. Pliocene[2]. Furthermore the extinction of various members of the late Tertiary and Quaternary fauna did not take place simultaneously in the different regions. The value of palaeontological data in establishing divisions within recent geological times could therefore not be absolute.

Another basis on which a time-division has also been attempted in Europe is that of physiographic cycles of erosion and deposition[3]. This system, however, does not meet all the difficulties. In certain parts of Europe glacial phases were associated with destructive erosion while in others the same phases were marked with extensive deposition (by either fluvial, fluvio-glacial or æolian processes). We have seen, in particular, that river terraces in the upper courses (associated with glaciations) had a different date and origin from those in the lower courses (associated with base-level). This

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[1] L. S. B. Leakey (1934*a*, p. 25), has attempted to revive E. Haug's palaeontological criterion (as referred to in R. Vaufrey 1930, p. 433), that: "If any members of one or more genera of *Elephas, Bos* or *Equus* (however primitive) occur in a deposit, this latter is more Pleistocene than Pliocene". Geologists are still doubtful, however, about the principles on which the division between the Pliocene and the Pleistocene has been attempted in E. Africa (where Leakey has been working). See remark of P. G. H. Boswell at end of L. S. Leakey's work 1933*a*, p. 211.

[2] In N. America A. S. Romer (1933, p. 57), put forward the generalization that "the Pleistocene differs from the Pliocene mainly in evolutionary process within groups, together with some immigration and a small amount of group extinction".

[3] This system, as worked out by M. Boule, H. Obermaier, M. Gignoux and others, is alluded to in R. Vaufrey (1930), p. 433.

non-uniformity of the physiographic cycles renders their system of dating rather unsafe. Perhaps a combination of both the palaeontological and the physiographic methods renders the nearest solution. But, as we have already mentioned the authorities are still divided amongst themselves and the question remains open.

In the foregoing pages, therefore, the sub-divisions of recent geological times have been referred to only in the most general of terms. In particular, the term Quaternary has been used rather loosely, while that of Plio-Pleistocene has been taken to include both the Uppermost Pliocene and the Lower Pleistocene. It may have been noted, however, that in our Table XII an attempt has been made to adopt the German term of "Diluvium" in so far as Middle and Lower latitudes are concerned. This is almost purely based on the climatic and physiographic cyles which (though somewhat different from Europe) are fairly homogeneous all over the Saharan, Sudanese, Sub-Equatorial and Equatorial zones. Speaking generally, a pluvial phase was usually characterized in these regions, first by a short stage of violent destructive erosion (preparing drainage systems, etc.), and then by a long phase of deposition [1]. An interpluvial phase was, on the other hand, usually marked by surface erosion (subaerial denudation) of the soft (drift) materials (silts, gravels etc.) deposited previously under pluvial conditions [2]. Furthermore, the physiographic record in these regions (Mid. and L. latitudes) has been very much simplified by the fact that there have been only two Pluvials and one Interpluvial. It may be therefore convenient to term the 1st Pluvial, the Interpluvial and the 2nd Pluvial as the L., Mid. and Up. Diluvium respectively. Each of these has had its own physiographic record.

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[1] There was, however, a certain amount of local variations from this general rule. At places where no drainage system existed in Pre-Pluvial times, the stage of erosion would naturally continue until such systems are fully evolved. This may render a pluvial phase more particularly associated with erosion than with deposition. It is quite possible, on the other hand, that in certain areas (*e. g.* deltas and L. courses of streams with high base-level) deposition may remain as the dominant physiographic feature right through a pluvial phase.

[2] In particularly arid regions, however, an Interpluvial may be also characterized by accumulation of sands (dunes, etc.) and loess-like dust on wide areas and open plains and of breccia in valleys (whose courses become choked with angular detritus).

The phase which preceded the Diluvium (and which corresponded to the Pre-Glacial of Europe) may be termed as Pre-Diluvium, while that which separated it from the Recent (and which corresponded roughly to the close of the Late-Glacial and the beginning of the Post-Glacial of Europe) may be labelled Late- or Post-Diluvium. This may offer a temporary system of physiographic dating, though it must, of necessity, remain subject to future correction in the light of more detailed faunistic or other data that may be forthcoming from these regions.

APPENDIX A.

NOTE ON THE RECENT PHYSIOGRAPHIC HISTORY OF THE L. NILE VALLEY.

The recent physiographic history of the L. Nile Valley has been incidentally referred to in the preceding Part; but it needs a special note. The tendency amongst recent workers in this region is to regard this part of the valley as the result of normal water-erosion [1], though this latter might have worked along some favourable line (or lines) of structural weakness [2]. Broadly speaking, the recent history of this L. Nile Valley lies in two main physiographic cycles : First in Miocene (or perhaps in late Oligocene) the tableland of Eocene deposits was raised to an unknown height, with the result that an Oligocene river (or river-system, presumably the *Ur-Nil* of Blanckenhorn, which joined the sea N. W. of the Fayyoum) carved a long gorge through which the Nile still flows [3]. This was entirely a phase of erosion, and huge land-slips of limestone on the sides of the valley show how this latter was widened. Then in Pliocene times (perhaps L. Pliocene) the sea rose (or the land subsided?) so that the valley became a long arm of the

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[1] K. S. Sandford and W. J. Arkell (1929*d*, p. 70), are definitely against the suggestion that the formation of this slot-like valley was in any way connected with rifting. They even refuse to accept Ball's suggestion (see J. Ball, 1907, p. 105; also work of R. Fourtau, 1905), that the changes in the river course at the Aswan Channel were connected with tectonic activity (see K. S. Sandford and W. J. Arkell, 1933, pp. 57-59).

[2] M. Blanckenhorn (1921, pp. 187 and 189 and map Tafel 1), suggests the existence of "*Bruchlinien*" between Cairo and El-Fashn (Lat. 28° 50′), on the one hand, and Assiut and the Qina bend on the other. K. S. Sandford (1934, pp. 2 and 4-8), denies this, but he admits the existence of flexures, fractures and other structural deformations which must have helped erosion.

[3] See K. S. Sandford and W. J. Arkell (1929*d*), p. 70. According to M. Blanckenhorn (1921, pp. 186-187; see also his work 1902), this *Ur-Nil* continued regularly from Mid-Cretaceous to Pliocene times, though it was strongest in Oligocene. This author also dates as Pliocene the main change from *Ur-Nil* to the present Nile. It is now practically certain, however, that the change took place somewhat earlier (see K. S. Sandford 1934, p. 3 and K. S. Sandford and W. J. Arkell, 1939, pp. 17-18).

Mediterranean [1]. Then, some time in the Upper Pliocene, the sea retreated again and the present régime of drainage was gradually established. At present the Pliocene marine sediments of this gulf stand as high as 180 metres above sea-level. A series of terraces have been cut into them at the approximate heights of 110-100, 65-60, 50-45, 30, 17-15, 10-8 and 3 metres above the present valley level [2]. Hardly anything is known about the exact dates of the first (higher) three, beyond the fact that they could be roughly attributed to the Plio-Pleistocene [3]. The latter four, on the other hand, have yielded implements as follows [4] :

30 metres : Early Chellean and Chelleo-Acheulean. Rolled and unrolled. Many specimens worked of pebbles. Also few Clactonian-like flakes.

17-15 metres : Chelleo-Acheulean and Acheulean. Rolled and unrolled. Also some small and rather crude flakes.

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[1] It has been shown by K. S. Sandford and W. J. Arkell (1933, p. 83 and map at end), that the gulf extended further south than Udfu (Edfu).

[2] See K. S. Sandford and W. J. Arkell (1928*a*), p. 17; (1928*b*), pp. 18-25; (1929), pp. 67-68; (1929*d*), pp. 70-71; (1933), pp. 18-47 and 82-85 and (1939), pp. 38-45, 49-60 and 92-96.

[3] K. S. Sandford and W. J. Arkell (1933), pp. 19-20. It is interesting to note that in Nubia the two higher terraces are represented by bare rock-platforms, while the 50-45 m. and 30 m. ones are covered only with very thin gravel spreads. The corresponding terraces in Upper Egypt, on the other hand, have a covering of gravels, etc. The difference between the two cases is attributed by Sandford and Arkell (1933, p. 18), to later erosion in Nubia (depriving its terraces from the gravels which once covered them). At the same time, however, these authors (1933, compare p. 31 with p. 85-86), think that the Pluvial Period (and its associated erosion) came to an end in Nubia at an earlier date than in more northerly latitudes. This leads to contradiction as the high terraces of Upper Egypt, where the rainfall and erosion were more powerful and more prolonged, still retain their gravel covering. Indeed, there is better reason to conjecture that at the time of the formation of the higher terraces, the Nubian part of the river belonged to its Upper course, where erosion—and not deposition—was most dominant. It is possible that the Nubian terraces never possessed the same gravel covering as those of Upper Egypt. The Abyssinian streams draining northwards do not appear to have ultimately found their way to Nubia and Egypt until a comparatively very recent geological date (*vide* a little *infra*). Before that, they may have lost themselves either over the Sudan Plain [like the Blue Nile which had to build up a flood plain and a levée system in the Gezira (Djazirah) region, *vide supra* the section on the E. Sudan in Part I], or in the deserts of southernmost Nubia and N. Erythrea (as the Khor al-Djash and Khor Barakah still do).

[4] See K. S. Sandford and W. J. Arkell (1933), p. 86.

10-8 metres : Very scarce so-called "Egyptian Mousterian" (*i. e.* Levalloisian) implements.

3 metres : Typical or rather Late so-called "Egyptian Mousterian" (*i. e.* Diminutive Levalloisian).

The interval occupied by the formation of the highest of these terraces (the Chellean) is thought to have been very long compared with the others[1]. The latter two, on the other hand, belong (more or less) to two stages of one and the same culture phase. After the formation of these terraces the Nile appears to have deepened its lowermost course to an unknown depth. In Middle Egypt it cut a deep channel which was later on filled with more recent and entirely foreign mud. This latter differed in provenance and constitution from the coarser material which came from the Red Sea Hills, and which was responsible for the building of the terraces proper. Abyssinian mud as such does not appear in L. and Middle Egypt until a very recent (and apparently double) phase of aggradation which corresponded roughly to Post-Palaeolithic culture stages[2]. It should be noted, however, that the story in Uppermost Egypt and Nubia is somewhat different from that further north. The above mentioned phase of degradation in the North was counteracted by a phase of aggradation (end of Mid. Palaeolithic and Early Up. Palaeol.) in the South[3]. This aggradation was marked by increased deposition of Abyssinian mud in this region. The mud has largely masked

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[1] K. S. Sandford and W. J. Arkell (1933), pp. 72-73 and 83.

[2] Of course it may be argued that as during the Pluvial Period the local supply of rainfall in Egypt increased the erosive power of the river in its Egyptian section, the deposition there of the soft mica flakes of the Abyssinian mud was rendered impossible. They may have been regularly washed down into the Mediterranean. It would be paradoxical, on the other hand, if the Abyssinian mud had arrived in appreciable amounts during the Early and Middle Diluvium, that it has left no traces even in the basin-like tracts of the valley.

[3] The important difference in aggradation and degradation between the lowermost and the middle courses of a river is not always easily detected in the study of physiographic cycles. A lowering of the land in the lowermost part of a valley (or a relative rise of the sea) may help aggradation in that part, while at the same time leading to degradation higher up-streams (as it shortens the profile which has to re-adjust itself). The opposite may happen (though to a less marked extent) if the lowermost part is uplifted (as the stream would then have to cut its way through the uplifted sill, which may form a natural dam for waters higher up-streams).

the lower terraces and at Wadi Halfa it reached as high as 30 metres above the present level of the river[1]. The aggradation, however, soon gave way to degradation about middle Sabylian (Egyptian Upper Palaeolithic) times (*i. e.* some time before degradation gave place to aggradation in L. and Middle Egypt). At the present day the river is still degrading its course in Nubia (except for artificial interference), while it is aggrading it in Egypt proper (especially in L. Egypt)[2].

The exact fitting of the terrace succession and the later physiographic phenomena in the L. Nile within the climatic frame-work we have worked out in the preceding Part is a difficult matter. According to Sandford and Arkell themselves the Pluvial Period in N. E. Africa continued uninterruptedly from the Pliocene right down to the Upper Palaeolithic (though arid conditions may have set in at an earlier date—Mid. Palaeol.—in the South)[3]. In this way these authors cut themselves off from associating any of the recent physiographic stages of the L. Nile with climatic changes. They assume (implicitly) that ample explanation of the terrace-succession could be

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[1] The late Mid. Palaeol. and Up. Palaeol. silt falls down as we go northwards, until by Nagʿ Hammadi it is almost at level with the present alluvium. North of this place still, it appears to be overlapped by the recent alluvium. See K. S. Sandford and W. J. Arkell (1929), p. 68 and (1933), pp. 25 and 38; also K. S. Sandford (1934), Fig. 13. This aggradation silt is micaceous and contains red jasper pebbles from Abyssinia.

[2] For further diagramatic representations of these cycles of degradation and aggradation see K. S. Sandford (1934), Figs. 18 and 19 and K. S. Sandford and W. J. Arkell (1939), Fig. 22. The story of Post-Palaeolithic aggradation in L. Egypt, however, appears to have been more complicated than conceived by Sandford and Arkell. The Maʿadi Excavations' Staff (Prof. M. Amer and others) of the Faculty of Arts, Fuad I University (Cairo) has recently (1940) discovered Abyssinian silt at a level some 15 m. (or more in places?) above present alluvium. This was found chiefly in the Turah area, south of Maʿadi. The silt was underlain by a bed of small gravel in which the present writer has found what appear to be Final Palaeolithic (or Pre-Neolithic?) tools of a microlithic character (to be published later on, in one of the Maʿadi Excavations Reports). We must assume that after the degradation of the late Upper and the Final Palaeolithic (including the Pre-Neolithic?) the river first aggraded its valley in L. and parts of Mid. Egypt to a level of 15 m. (or more?), then degraded it to an unknown level, and then aggraded it a second time in late prehistoric and historic times. This latter process is still going on. The accumulation of mud in the Delta may have been further enhanced by the sinking of its fringes during historic times (*vide* a little *infra*).

[3] Sandford and Arkell (1933), compare p. 31, with pp. 85-86.

found in the study of changes in base-level [1]. If this be so, one would expect to find complete concordance between the Nile terraces, on the one hand, and the Mediterranean beaches, on the other. Unfortunately, however, no such beaches occur on the Egyptian coast. Furthermore, the apparent close correlation between the Nile terraces and the raised beaches of the W. Mediterranean offers, in fact, some discrepancies which could not be explained by changes in sea-level. In particular, the recent phases of concurrent degradation and aggradation in different parts of Egypt and Nubia could not be entirely equated with similar phases in the W. Mediterranean. Indeed, it would be out of the question to attribute the aggradation (in late-Upper Diluvium) up to the height of 30 metres as far south as Wadi Halfa to a rise in the waters of the Mediterranean. Apart from the impossibility of such a process on hydro-physiographic grounds, the fact that this aggradation was partly accompanied by degradation in L. Egypt is definitely against any such rise in the sea-level. There is good reason to think, on the other hand, that this Nubian aggradation was entirely due to a hydrographic change in the Nile régime [2]. Furthermore we have seen that the terraces of the Nile were formed almost entirely of local material which was brought into the valley by local rainfall, especially on the Eastern Desert. It would be therefore illogical not to take the climatic changes (the evidences for which have been fully elucidated in Part I) into account in attempting an explanation of these terraces. In this respect it may be useful to add that during a pluvial phase there would be active erosion on the Red Sea Hills and more material would be brought into the Nile slot. Given favourable conditions (*i. e.* a comparatively high base-level), this material would be resorted by the river and spread

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[1] See K. S. Sandford (1934), pp. 51-52. Also verbal information kindly given by Dr. Sandford.

[2] It is probable that although, for some reason or other, the drainage of the Abyssinian tributaries towards the Nile might have begun on a much increased scale at the beginning of the 2nd Pluvial (as testified *e. g.* by the accumulation of the Blue Nile mud on the Djazirah Plain at a time which could be best equated with this Pluvial—*vide supra* the study of the E. Sudan in Part I), the Abyssinian mud did not reach Nubia and Up. Egypt on any appreciable scale until after Mid. Palaeol. times. As it has been pointed out (*supra* footnote 1 on p. 117), the Abyssinian streams would have to build up both flood-plains and banks before they could traverse the semi-arid zones of the N. Sudan (including Djazirah Plain).

in the form of terrace-mantels. During an Interpluvial, on the other hand, the supply of rainfall would be much reduced and the Wadis and presumably also the Nile would limit their beds and cut them down. Even a rise in the sea-level during such an interval (which corresponds to an Interglacial in N. latitudes) could hardly lead to the formation of a terrace, as the material is lacking. To sum up therefore we find that the deposition and the cutting of the faces of the Nile terraces were more complicated in nature than we know from most of other rivers. They could only be adequately explained by taking into account three different factors : 1) changes in base-level; 2) changes in the supply of water and material and 3) changes in the hydrographic régime of the Nile.

In the light of these three phenomena we shall now attempt a general correlations of the physiographic stages in the recent history of the L. Nile. For changes in sea-level we shall take as a working hypothesis the one referred to in our treatment of the Mediterranean Basin : *i. e.* that high sea-levels coïncided with Interglacials and low ones with Glacials. For the climatic changes we have constructed (on the data elucidated at the close of Part I) a general curve of Diluvial climates in N. E. Africa (see Diag. 6, Pl. V). On this were marked the stages as will be dealt with below. As to the hydrographic changes they do not seem to have played any conspicuous part in the Egyptian section of the Nile until the closing chapters in the physiographic story of the river. These changes have already been referred to in the preceding paragraphs and footnotes. It should be made clear at the outset, however, that the conclusions arrived at in the following summary could only be regarded as tentative. Their main purpose is to help to fix the place of the culture phases of Palaeolithic and Neolithic Egypt in the framework of climatic and physiographic changes as we infer them at present.

For purposes of brevity the physiographic stages [1] have been numbered

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[1] The physiographic stages are here numbered from the earliest to the most recent. In Part I, on the other hand, we have generally followed a system which starts with the most recent phases and proceeds backwards. The present Appendix may therefore be considered as a summary of physiographic events (in the region) given in true chronological order.

on Diag. 6, Pl. V, and it may suffice to give the following descriptive account on each of these stages (beginning with the earliest) :

I. Equivalent of the pre-Mindel phase (*i. e.* mainly the Günz-Mindel Interval) and the advance phase (*Vorstossphase*) of Mindel. Sea first high and then gradually falling towards end. Gradual increase in precipitation. Building up of the 50 metres terrace.

II. Equivalent of the maximum of Mindel. High rainfall, but sea very low. Phase of destruction. Deepening of the river-bed and "cutting" of the face of the 50 metres terrace.

III. Equivalent of the retreat phase of the Mindel, the whole of the Mindel-Riss Interval and the advance phase of the Riss. Sea-level first rising, then remaining stationary at a high level and then gradually falling. Rainfall, on the whole, abundant. Building up of the 30 metres terrace (with its Chellean culture).

IV. Maximum of Riss. High rainfall, but very low sea-level. Another phase of destruction. Deepening of the river-bed, and "cutting" of the face of the 30 metres terrace.

V. Phase of gradual retreat of the Riss (perhaps with a stadial oscillation?). Rainfall gradually decreasing, but sea-level also gradually rising. Building up of the 17-15 metres terrace (with its Acheulean culture).

Taken together, Stages I-V make up the L. Diluvium. They constitute one major Pluvial. Outside the Nile Valley they may have been characterized by ordinary torrential and sub-aerial erosion in the Fayyoum and other W. Depressions.

VI. The Riss-Würm Interval. High sea-level, but very dry climate in N. E. Africa, and presumably also in lower latitudes. Nile probably only a trickle. Narrowing and deepening of its bed and "cutting" of the face of the 17-15 metres terrace.

This Stage represents the Middle Diluvium during which desert-erosion was also dominant in the W. Depressions.

VII. Short advance phase of Würm. Sea-level slowly falling; while rainfall gradually increasing. Building up of the 10-8 metres terrace (which has so far yielded only a few Levalloisian implements).

VIII. *A*. Maxima of Würm I and Würm II (separated by insignificant interval). High rainfall (two sub-maxima not clearly distinguisable from one another), but also very low sea-level. Phase of destruction. Deepening of river bed and "cutting" of the face of the 10-8 metres terrace.

B. Retreat of Würm II, Achen Retreat and advance of Bühl. Rainfall somewhat reduced, but sea-level slightly raised up. Building up of the 3 metres terrace (with its Levalloisian industries).

C. Maximum of Bühl. Increase in rainfall but also fall in sea-level. Short phase of destruction. Nile abandoning the 3 metres terrace and beginning deepening of its channel in L. and Mid. Egypt. It is probable, however, that at this stage Nubia began to receive Abyssinian mud on a somewhat increased scale. This part of the L. Nile Valley may have, therefore, been characterized by aggradation while Middle and L. Egypt began to suffer from deepening of channel.

Stages VII and VIII correspond to the 2nd Pluvial (except for its retreat phase), and make up the Upper Diluvium. During the phase of the building up of the 10-8 metres terrace the Nile broke into Fayyoum and the 35 metres lake was formed. As the Nile deepened its channel the lake in the Fayyoum fell down (though intermittently).

IX. *A*. End (or closing stages) of the Late-Glacial phase. Sea rising but only very gradually as large quantities of water were still held as remnants of ice-caps. Saharan rainfall diminishing. Nile still degrading its lowermost course, and the process of degradation gradually proceeding southward towards Nubia.

B. Transition leading into the Post-Glacial phase proper. Increased melting of ice-caps and rise of sea-level. Saharan rainfall still diminished; but both the rising level of the sea and the increase in Abyssinian mud arriving L. Egypt appear to have gradually counteracted the effect of the degradation process in lowermost course of Nile. In Nubia, on the other hand, degradation continued unchecked.

This Stage constitutes the Late- or Post-Diluvial phase. The falling Nile was cut from the Fayyoum, where the lake may have dried up.

X. The period of Climatic Optimum of N. Europe [*c.* 5600 (or even before?)-2500 B. C.]. General warmth and world-wide rise in sea-level (melting of residual ice-caps). Increase in rainfall in Mid. and Lower (Sub-Equatorial and Equatorial) latitudes. (Continued) aggradation in lowermost Nile and degradation in Nubia. The wet phase was partly connected with the Egyptian Neolithic (though it presumably started a little before the Neolithic as we know it, and certainly continued after it). It had more than one sub-maximum (though gradually subsiding) and after 2500 B. C. desert conditions set in very gradually. The accumulation of Abyssinian mud in L. and Mid. Egypt during this stage did not represent a simple process. At first (in late Pre- and Proto-Neolithic times?) this mud appears to have been quickly accumulated (as least in N. Middle Egypt) to a level 15 metres (or more) above the present alluvium (*vide supra*, footnote 2 on p. 153). Then, for some reason or other (perhaps decrease in Abyssinian rainfall and Nile discharge?), the muddy waters of the river did not reach the high outer borders of its flood plain. Inundations became lower and lower and marshes less extensive. Judging by archaeological data (*vide infra*, close of Section iii of Part II) this lowering process, which may have even started in Neolithic times (?), did not become fully developed (*i. e.* reach the point of equilibrium) until the so-called Mid. Pre-Dynastic stage (or slightly earlier?). But the river soon adjusted itself to the new level (below present one) and silting-up and aggradation were resumed in the immediate neighbourhood of its course as well as in the Delta. At the same time, however, the high silts of the outer borders of the plain (deposited perhaps since late Pre-Neolithic and Early Neolithic times) were eroded by occasional torrents descending from the plateau.

XI. Present phase. Slight fall in sea-level and general (though oscillating) decrease in rainfall. But more Abyssinian mud reaching Mid. and L. Egypt (instead of being deposited on the Sudan Plain or in Nubia). Aggradation in lowermost course of Nile enhanced by sinking of Delta [1]. Continued degradation in Nubia.

Stages X and XI represent the Recent phase. At first the rising L. Nile broke into the Fayyoum (Proto-Neolithic?), but later on it appears to have communicated less freely with that depression [2]. The physiographic story of the L. Nile during these two stages, however, remains far from fully elucidated, and the remarks noted above must be regarded as only provisional.

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[1] Reference to sinking within historic times of certain parts of Egyptian coasts, in J. Ball (1939) pp. 66-67; also K. S. Sandford and W. J. Arkell (1939) pp. 81-82. On the sinking of the N. of the Delta see work of C. Audebeau, *Note sur l'affaissement du nord du Delta égyptien depuis l'Empire romain, Bull. Inst. d'Égypte*, t. I, 1919.

[2] It is possible that the suggested quick aggradation at the close of Stage IX and the beginning of Stage X may have led to the choking (with mud) of the Hawwarah Channel connecting Nile with Fayyoum. The severing of relations continued during the middle part of Stage X, when the Nile was apparently lowering its bed. Then the rise in the level of the river at the close of Stage X and during Stage XI may have ultimately made possible again the free flow of the Nile into the Fayyoum. However, the exact story of this connection between Nile and Fayyoum still needs clarification.

PART II.

THE PLACE OF EGYPT IN THE CULTURE-SEQUENCE OF PALAEOLITHIC, NEOLITHIC AND POST-NEOLITHIC TIMES.

A MORPHOLOGICAL STUDY OF THE CULTURES; AND THEIR DISTRIBUTION IN RELATION TO CLIMATE AND ENVIRONMENT.

PART II.

SECTION I.

THE LOWER AND MIDDLE STAGES OF THE PALAEOLITHIC.

A STUDY OF THE ORIGINS AND DISTRIBUTIONS OF CULTURES IN THE OLD WORLD :

WITH SPECIAL REFERENCE TO THE SAHARO-ARABIAN AREA.

INTRODUCTORY :

The Eolithic and the Palaeolithic. Classification of Palaeolithic Techniques in the Old World.

We have already seen in Part I that the last stages in the geological history of the world were characterized by a series of oscillations in climate reflected in fauna and flora. The present Part tries to fit the culture-sequence within the climatic and bio-geographical frame-work already outlined. Unfortunately, in the present state of our knowledge, it is not possible to start at the end of the story and proceed backwards, as we did in the study of climates, because if we did so, we should have (in the first place) to hold the ends of the "threads" practically all over the world—an impossible task for a work of the present nature; and secondly, no sufficient data would be available on the various regions with which we shall have to start. The last formed branches of the genealogical tree of cultures are so many, so complex and so little known that, to start with them would not only be impracticable but also entirely misleading. We therefore find it safer to start with the stem, *i. e.* the Palaeolithic, about whose main outlines *comparatively* more is known than about the later stages.

Before we deal with the Palaeolithic, however, a word must be said abont

the Eolithic, whose nature is still a matter of controversy [1]. It is clear that the Chellean and even Pre-Chellean cultures were much too advanced to have represented the lowest stages of a technical evolution. But the stratigraphical and technological gap between the earliest Chellean and the so-called Eolithic could not be easily bridged over [2]. Except for recent light from E. Africa (of which the evidence is not fully elucidated as yet) the direct ancestry of the lowermost Palaeolithic is still unknown. It appears that the greater part of the so-called "eoliths" of Tertiary times represented the work of natural agencies (natural fracture, differential pressure, rolling, etc.) [3], while only some of them may have been shaped by a human-like animal [4]. The lower group of these eoliths (that of the Eocene and Oligocene) may be disposed of on purely palaeontological grounds. The oldest known fossil anthropomorph, the *Propliopithicus* of the Oligocene, was probably not larger than the present-day human baby [5]. As pointed out by Obermaier, it would be unreasonable to attribute to such a small creature the use of such relatively large stones as the "eoliths". On the other hand, it should be pointed out that the existence of man or a human-like creature in the Uppermost Tertiary (Pliocene) is accepted by practically all human palaeontologists [6]. This may

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[1] For recent accounts in favour of the existence of eoliths, see J. R. Moir (1921, 1923 and 1927), pp. 14-23; for accounts against their authenticity, see especially M. Boule (1905), pp. 257-267; (1923), pp. 111-138. On more moderate (less conclusive) accounts, see H. Breuil (1922), pp. 226-228; H. Obermaier (1924), pp. 1-18 (1925 *b*), pp. 99-107 (less favourable than Breuil as to their authenticity as artifacts). We may also note that suggestions have often been put forward of a Pre-Palaeolithic wood- and horn-culture (the latter case assuming that man just robbed his game of their defensive weapon and used it against them). See H. Obermaier (1916), pp. 104 ff.; O. Menghin (1931), pp. 89-91; also mention in H. Breuil (1932 *c*), p. 7.

[2] On this point, see F. Wiegers (1928), p. 158.

[3] Also in some cases animal agencies; *e. g.* so-called «*podoliths*» produced by the feet of moving animals.

[4] Eolithic-like artifacts occur right through the recognised culture phases from the L. Palaeol. to the Neolithic, and even down to the present day (in Australia). They are always, however, associated with more definite tools which give the level in which they are found its specific character. In the Tertiary, on the other hand, these so-called «eoliths» are found alone, and they show no sign whatever of evolution right through that geological period.

[5] H. Obermaier (1924), p. 17 and (1925 *b*), p. 104.

[6] See *e. g.* M. Boule (1905), p. 267.

lend support to the possibility of some of the finds belonging to this phase (especially the Up. Pliocene) being authentic artifacts [1]. Indeed such finds (usually crude flakes) may represent a remote ancestor of part of the L. Palaeol. facies, especially the recently differentiated flake culture of the Clactonian [2]. None-the-less, there has so far been no direct physiographic evidence as to the relation of the so-called Eolithic phase to the Palaeolithic proper either in Europe or outside it (except in E. Africa where the Pre-Palaeol. facies is not Eolithic *sensu stricto*); and we therefore prefer to cut the Eolithic phase from our present treatment.

The Palaeolithic may be divided into three sub-phases; L., Mid. and Upper. Until quite recently the first of these was said to be associated with a *coup-de-poing* industry, and the other two with a flake or blade technique. It is now generally agreed, however, that flakes were used right from the beginning of the L. Palaeolithic, while *coups-de-poing* persisted into the Mid. Palaeolithic. The result of the new technological classifications is that the dividing line between the L. and the Mid. Palaeolithic has become less definite; and for this reason (amongst others), we propose to deal with the two sub-phases in the same Section. This does not mean, however, that the Middle Palaeol. was necessarily evolved from the L. Palaeol., as in fact there is good reason to think that it was heralded by the contact of a new pure flake culture with the old *coup-de-poing* and flake technique. It would be too much to attempt to follow the stages of evolution and the distribution (over the Old World) of each of these two culture-groups, but these may be summarily suggested in the appended Maps (Nos. 1 and 2 on Pl. I and II), which are based on the material available at present. It is hoped that, in the following discussion of the material represented on these maps, some light may be thrown on the respective parts played by the various regions of the Old World in the culture complex of the L. and Mid. Palaeolithic.

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[1] See H. Breuil (1922), p. 228; also reference in W. J. Sollas (1924), pp. 104-106; M. C. Burkitt (1933), pp. 103-107; C. Hawkes (1933), p. 276.

[2] On this culture and its status, see H. Breuil (1932), p. 126-130. This author (*ibid.*, pp. 132, 171-173) includes within the Clactonian some of the industries hitherto regarded as Eolithic (*e. g.* the Mesvinian).

Starting with W. Europe (compare Map 1), we find that the L. Palaeol. is represented by cultures from Pre-Chellean times onwards (including both core and flake facies) [1]. A little to the East (*i. e.* in C. and E. C. Europe), however, this phase is only represented by Up. Acheulean and Micoquian facies, which were probably contemporaneous with the so-called Pre-Mousterian flake industries [2]. It is also interesting to note that in the Italian Peninsula the Chellean is very poorly represented (Island of Capri), while the typical and advanced facies of the Acheulean are relatively abundant [3]. This lends support to the general belief that the spreading of the L. Palaeol. in Europe was from West to East. The existence of a crude Chellean (or Pre-Chellean) culture in W. Europe (especially N. France), however, does not necessarily mean that the L. Palaeolithic originated in this region (which is more or less in a corner-position in relation to the other parts of the Old World) [4]. Indeed the opinion is now generally accepted that the cultures of this early phase were introduced into W. Europe from somewhere in the South, probably over the Iberian Peninsula [5].

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[1] For general accounts on the L. Palaeol. of W. Europe, see H. Obermaier (1924), pp. 66-86; F. Wiegers (1928), pp. 23-94 and 151-154; W. J. Sollas (1924), pp. 133-202; G. G. MacCurdy (1924), vol. I, pp. 103-127.

[2] For recent accounts on the Palaeolithic of C. Europe in general, see V. J. Fewkes (1929), pp. 20-26; see also H. Obermaier (1924), p. 88. It is assumed here that the reader is acquainted with the main outlines of the technology of Palaeolithic cultures. Information on the different facies may be found in any general work on Prehistory. In the following pages we shall give only those technological details that may be necessary for persuing our argument.

[3] On the Italian L. Palaeolithic, see R. Vaufrey (1928), pp. 9-36.

[4] It may be noted that the existence in parts of W. Europe of the so-called «Chalossian» industry (with crude trihedral *coups-de-poing*) is now much doubted by many authorities. On this so-called «Chalossian» (from Chalosse, Landes), see E. Passemard's work (1924); also P. Dubalen (1924), pp. 1-4 and accompanying figures. For criticism of the authenticity of the stratigraphic levels and of the technique, see A. Vaysonne de Pradenne (1930), pp. 462-465 (1931), pp. 207 and 292-293; also R. Vaufrey (1931), pp. 223 and 661-662.

[5] See especially H. Breuil (1920), p. 11, where he suggests that the Chellean cultures have spread into W. Europe from Africa by way of both Iberia and Italy. The question of the Italian land-bridge, however, is now much in doubt, and reference will be made to this point a little later. It should be further made clear that the fact that the L. Palaeolithic is believed to have been introduced into W. Europe from the South, does not mean that all the sub-facies of the Chellean and Acheulean were introduced one after the other. It is quite probable that some of these sub-facies have evolved locally in W. Europe, though on lines more or less parallel to those followed in Africa. Indeed, it is possible that some of the Acheulean sub-facies may have actually evolved in W. Europe at an earlier date than they did in N. Africa (compare Tables XIII and XIV).

The question of the dating of the L. Palaeol. of N. W. Europe is a much more controversial matter. It would serve no practical purpose to go into all the details of argument between the different workers; but a tabular summary of their conclusions is given below (Table XIII).

From this summary we find that there are, on the whole, three main Schools: the one (represented by Breuil, on left-hand side of Table), which follows a system of long-chronology; the other (represented by Boule, on right-hand side of Table) which follows a system of short-chronology; and the third (Wiegers, etc.) which adopts an intermediate position between the two. It is interesting to note that, taken as a whole, the two extremist views are represented by experts whose work is either primarily (though of course not entirely) archaeological (Breuil) or predominantly palaeontological (Boule). On the other hand, the more moderate School is represented by those who approach the subject chiefly from the physiographic point of view. The faunae accompanying the cultural stages of the L. Palaeolithic throw useful light on the question of fitting these stages within the climatic sequence outlined in Part I. The fauna of the Pre-Chellean—or primitive Chellean—and the Chellean was typically warm. It included *Elephas antiquus, El. trogontherii, Hippopotamus major, Rhinoceros Merckii, Rh. etruscus, Rh.* cf. *leptorhinus, Cervus somonensis, Ursus spelaeus, Bison priscus*, etc. [1]. The Acheulean stage, on the other hand, had a more complicated faunal association. It was at first thought that its fauna was of a mixed character [2], but it has now been shown that it falls into three distinct sub-phases: 1) the L. Acheulean (or Chelleo-Acheulean) with a warm fauna of *El. antiquus, Cervus elaphus* and an *Equus* of a large size; 2) the evolved Acheulean with a relatively cold fauna including *El. primigenius* and *Rh. tichorhinus* (but not the reindeer); and 3) the uppermost Acheulean or Micoquian,

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[1] See Obermaier (1924), pp. 66-69; Wiegers (1928), p. 164; Briquet (1931), p. 23.

[2] See Ch. Depéret and E. Chaput (1921 *b*), p. 229.

Table XIII.

Chronological Table of the L. and Mid. Palaeolithic in W. Europe, according to H. Breuil (1930), (1932), (1937*a*), (1938*a*) and (1939*a*); A. Penck (1921); F. Wiegers (1928); A. Briquet (1931); H. Obermaier (1912), (1924) and (1925*b*); M. C. Burkitt (Brit. Isles only) (1932); R. R. Schmidt (1912); and M. Boule (1923). The Table reads upwards. (No time-scale is indicated.)

Abbreviations : Abb. = Abbevillian (used by Breuil to denote Chellean), Ch. = Chellean, Clac. = Clactonian, Ach. = Acheulean, Tay. = Tayacian (a flake industry derived from Clac. but affected by Levalloisian technique; see Breuil 1937*b*, p. 14): Mic. = Micoquian, Lev. = Levalloisian, Ms. = Mousterian, Aurig. = Aurignacian (Up. Palaeol.). L., Mid., Up. and Typ. = Lower, Middle, Upper and Typical. G. = Günz, M. = Mindel, R. = Riss, W. I. = Würm I.

CLIMATE.	BREUIL.	PENCK.	WIEGERS.	BRIQUET.	OBER-MAIER.	BURKITT.	SCHMIDT.	BOULE.
W. I. . . .	Typ. Ms. and Lev. V(-VI?).	Aurig.	Up. Ms.	Up. Ms. L. Ms.	Up. Ms.	Ms.	Ms.	Ms. Up. Ach.
R.-W. . .	L. Ms. Ach. V-VII (Mic.), Tay. II and Lev. III (?)-IV.	L. Ms.	L. Ms.	Mic.	Up. Ach. and L. Ms. Up. Ch. and L. Ach.	L. Ms. Up. Ach. Mid. Ach.	Ach. Pre-Ch. and Ch.	L. Ach. Ch.
R.	Ach. IV(-V?) and Lev. II.	Up. Ach.	Up. Ach.	Up. Ach.	L. Ch.	L. Ach. Up. Ch.		
M.-R. . .	Ach. (I-II?) III, Clac. II, Tay. I (and Lev. I?).	Ch.	L. Ach. Ch. Pre-Ch.	L. Ach. Ch. Pre-Ch.	Pre-Ch.	Ch.		
M.	Ach. II.							
G.-M. . .	Abb., Ach. I and Clac. I.							
G.								

with a warm fauna of *Elephas* (*antiquus*), *Rh. Merckii*, *Hip. major*, *Equus* cf. *stemonis*, *C. elaphus*, etc.[1]. In C. Europe, a fauna associated with Pre-Mousterian culture included *El. antiquus*, *Rh. Merckii*, *Equus* sp., *Bos primigenius*, *Bison priscus*, *Cervus elaphus*, *Sus scrofa* etc.[2]. The Mousterian phase proper appears first to have been accompanied by remnants of the Micoquian fauna and then to have become associated with a definitely cold fauna.

As may be seen from the Table, H. Breuil places the Chellean (which he now prefers to call Abbevillian) in the equivalent of the G.-M. Interglacial of the Alps. Apart from the fact that this spreads the L. Palaeol. over a very long stretch of time (beginning already in, or at the close of, the Pliocene)[3], it does not conform to all the physiographic facts known up to date[4]. Even from an archaeological point of view Breuil's conclusions may not be wholly acceptable[5]. We may note, for example, that the existence of a true Chellean (Abbevillian) industry in the Cromer (E. England) Forest Bed (which he equates with the G.-M.) as suggested by Reid Moir[6], or even in the Cromer Till, is still much open to doubt[7]. Also his scheme does not allow us to take a sufficiently proportunate account of the length of time occupied by the technological evolution of the various cultures. We find, for instance, that according to his scheme (compare Table XIII), the Levalloisian facies probably starts in M.-R. and does not reach its VIth stage until W. I or perhaps W. II, while the *coup-de-poing* industries pass through the whole of the Chellean (Abbevillian) and Acheulean I stages within the relatively short Interglacial of G.-M. At the same time, the Acheulean takes the whole of M., M.-R., R.

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[1] See H. Obermaier (1924), pp. 72-76; A. Briquet (1931), pp. 23-25.

[2] H. Obermaier (1924), pp. 85-86.

[3] Though of course the process of evolution through the L. Palaeol. was admittedly very slow.

[4] On these latter see *e. g.* Chaput and Briquet (1931); also Chaput (1928), pp. 69-94.

[5] The present writer is very deeply indebted to M. l'abbé H. Breuil for the particularly useful and illuminating discussions he had with him (while studying under his guidance at the Institut de Paléontologie humaine, Paris 1933-1934) on the question of chronology in Europe and elsewhere. Discussion or criticism given here and there of some of his conclusions does not invalidate in the least the immense value of his work for Palaeolithic chronology or his many contributions to prehistoric archaeology in general.

[6] J. R. Moir (1927), pp. 39-51.

[7] See *e. g.* reference in C. Hawkes (1933), p. 277.

and most of R.-W. to pass from its IInd to its VIIth stage. Furthermore, H. Breuil builds his dating of the sub-divisions of the Acheulean on the assumption that the Mindel-Riss Interglacial was divided into three sub-intervals; warm, cool, and relatively warm. We have seen, on the other hand, that the physiographic and faunal evidence is definitely in favour of the application of such a sub-division to the R.-W. Interglacial and not the M.-R. (*vide supra*, Part I, Table IV). If this be so, it would mean that the Acheulean series which he places in the M.-R. should be really transferred to the R.-W., in which case the gap between the Chellean (Abbevillian, which he places in the G.-M.) and the Acheulean would be further increased. The long-chronology system of Breuil does not therefore meet all the physiographic and climatological difficulties.

The short chronology system is equally difficult to accept. The fact that the warm fauna of *Elephas antiquus*, etc. is found with both Chellean and Acheulean does not necessarily mean that the two cultures belonged to the same Interglacial. It is quite possible that a glaciation in Europe did not always lead to the complete extinction of warm species. In particularly favoured spots (*e.g.* the Ligurian Coast), many of the so-called warm species could resist and survive (with some sort of adaptation). Apart from this, there is of course the usual process of migration southwards (towards S.-W. Asia), followed by a re-advance northwards after the passing away of severe conditions. Furthermore the remains of the warm fauna of Chellean and Acheulean times have been found in different stratigraphical levels (usually separated by a physiographic cycle); which makes it still more difficult to attribute them to one and the same Interglacial. It would also be inacceptable to many archaeologists to contract the whole of the evolutionary process from the crude industry of the Early Chellean (or Pre-Chellean) to the fine Micoquian within the last Interglacial (R.-W.).

Finally the group of physiographers who adopt an intermediate view between the two chronologies, place the Chellean and the L. Acheulean in the M.-R., the Up. Acheulean in the Riss and the Micoquian (and L. Mousterian) in the R.-W. Unfortunately, the physiographic data in W. Europe (especially N. France) is not always easy to interpret or to correlate. The L. Acheulean is placed at the close of the M.-R. because in places it lies below an old loess

attributed to Riss[1]. Part of this lower loess, however, is made up of *limon altéré*, whose secondary deposition must have taken place some time during the R.-W. Interglacial. It does not seem to have been always possible to distinguish between implements coming from this level of *limon* and those from the *unaltered* loess. Furthermore, we have seen that the relatively cold fauna of the Up. Acheulean (or rather fairly evolved Acheulean, to describe it more precisely), which is attributed by this School to the Riss, does not include the reindeer. This animal, however, occurs in formations of the Riss in various parts of W. C. Europe[2]. Indeed, it is not impossible that the loess which covers deposits containing L. Acheulean tools (and which is said to contain evolved Acheulean) may prove to belong to the cool windy interval which took place within the last Interglacial of Europe (equivalent of R.-W. of Alps). As we have already seen in Part I (*vide supra*, p. 16) this short cool episode was marked in E. England by strong continental winds (as shown by the occurrence of facetted pebbles in the formations of the middle part of that Interglacial). A Continental anticyclone which affected the British Isles to such an extent, could hardly have passed without affecting N. France. If this be accepted, it would be feasible to think that a certain amount of loess may have been formed in N. France during the cool and windy episode of the middle of the Riss-Würm[3]. To this episode may be attributed the evolved Acheulean industry and its cool fauna (which did not include the reindeer). We may therefore conclude that while accepting the possibility of a chronological system as put forward by certain physiographers, it is equally, or even more, feasible

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[1] See F. Wiegers (1928), p. 46; and A. Briquet (1931), p. 23.

[2] See H. Obermaier (1925 *b*), p. 410. It is important to remember that the Riss was more extensive than the Würm; so that, if the reindeer had spread to N. France in the latter, one would expect to find it there also during the Riss.

[3] It appears quite probable that during this cool episode, part of the Old Loess (of Riss) may have been disturbed and redeposited by wind action. So far as its *état physique* is concerned, a loess redeposited by wind occupies an intermediate position between the true old loess (of Riss) and the *limon* (or *Loess altéré*), which has been altered by *ruissellement* during the warmer intervals of the R.-W. Interglacial. None-the-less, it could be easily mistaken for the one or the other. This is the impression which the writer gathered during a study visit to the N. of France late in 1933.

to suggest that the Chellean alone occupied the Mindel-Riss Interglacial, while the three sub-facies of the Acheulean (the L. and evolved Acheulean and the Micoquian) corresponded (more or less) to the three sub-divisions of the last Interglacial [1]. The Mousterian probably started at the same time as the Micoquian, but, as we shall see later on, it continued well into the Würm glaciation.

The Question of Land-Bridges (and Culture Migrations) across the Mediterranean.

We must now turn to more southerly latitudes. But before we deal with N. Africa, a few words must be said on the question of land-bridges across the Mediterranean. The faunal and cultural connections between Europe and the Saharo-Arabian Belt are indisputable; and they could have taken place along three potential land-bridges : the Balkan-Asia Minor, Italy-Tunisia and Gibraltar. The first of these land-connections is very little investigated, though it is probable that during a large part of recent geological times, the Black Sea was an inland lake, while the Ægean largely stood above water. Remains of the *Rhododendron ponticum* and of *Elephas antiquus* have been found in some of the Pleistocene formations of the Ægean Islands [2]. It is also possible that part of the fauna of the late Pleistocene (Up. Diluvium) of Syria and Palestine may have arrived originally from S. E. Europe across Anatolia (?). Indeed, certain authorities incline to think that all the faunal connections between Europe and the S. shores of the Mediterranean during Quarternary times took place over this easternmost land-connection [3]. Unfortunately the cultural evidence from this eastern bridge is very little known. So far, only a few rather doubtful finds of the L. Palaeolithic have been reported from Asia Minor [4], while no such finds have turned up from the Balkan Peninsula. As we shall see in the following Section of the present Part, however, there is strong evidence of the existence of cultural relations between S. W. Asia and

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[1] Did a Chelleo-Acheulean phase correspond to the Riss ?

[2] For references *vide supra,* Part I, footnotes 5 on p. 58 and 1 on p. 59.

[3] *e. g.* R. Vaufrey (1929 *a*), p. 19 and (1931 *a*), pp. 362-363.

[4] See G. G. MacCurdy (1924), vol. I, p. 128 ; also H. Obermaier (1926), p. 1.

S. E. (and C.) Europe in Up. Palaeol. times; but these relations have almost certainly taken place over the Caucasus. Nevertheless, it is probable that in the latter part of the Pleistocene, the relations of land and sea in the region of the Dardanelles and Bosporus were somewhat different from those of today [1].

The second potential land-bridge is that over the Strait of Sicily-Tunisia. In recent years, however, R. Vaufrey has adduced evidence that this Strait has been open since Pre-Pleistocene times [2]. According to him, this is illustrated not only by the discovery of pygmy elephants (*éléphants nains*) in Malta, Sicily and S. Italy (showing local degeneration in a *cul-de-sac*), but also by the fact that no finds belonging to the L. Palaeolithic have as yet been recorded from Sicily or the extreme S. of the Peninsula [3]. In this respect, it is also interesting to note that no Palaeolithic finds have turned up as yet from the extreme north-eastern horn (corner) of Tunisia, which—had a land-bridge existed at all—would have served as the African head for such a bridge [4]. On the other hand, there is every indication that the L. and Mid. (and also Up.) Palaeolithic of Italy were introduced thither from Europe, especially during phases of severe climatic conditions on that Continent [5]. The fact that, as we shall see later on (also *vide infra,* Section II), the cultures introduced into

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[1] See reference to recent geological changes in this region in J. L. Myres (1906), pp. 542-549.

[2] See especially his work (1929) ; also (1929 *a*), pp. 18-20. Though accepted by the majority of workers, the conclusions of Vaufrey have not yet attracted unanimous approval.

[3] On the elephant remains in Sicily and Malta, which Vaufrey attributes to the Würm (when Malta was presumably linked to Sicily and S. Italy), see R. Vaufrey (1929), also (1929 *a*), p. 19. Ont he question of the distribution of L. and Mid. Palaeol. finds, see R. Vaufrey (1929 *a*), p. 18 ; also (1928), pp. 23-24, 81-84 and 116-159 ; see also map accompanying work of A. Gori and L. Cardini (1933). The middle Palaeolithic is also absent from Sicily ; compare also our Maps 1 and 2 on Plates I and II.

[4] See R. Vaufrey (1927), pp. 151-154 and (1929 *a*), p. 18.

[5] The probability is that the L. Palaeol. was introduced from the N. W., while the Mid. (and presumably also the Up.) Palaeol. were introduced from the N. E. R. Vaufrey (1928, pp. 36, 81-84 and 113-115) does not incline to accept the possibility of the L. Paleaol. having been introduced from the N. W. ; but he does not seem to account for the fact that no L. Palaeol. finds are known from the regions neighbouring Italy to the N. E.

Italy have gradually tended to acquire a distinctly local facies, would rather suggest that we are dealing here with a region which was relatively out-of-the-way, and not with a thoroughfare which connected two Continents.

As to the Strait of Gibraltar, it is now generally agreed that it has been open at least since the close of the Pliocene [1]. It could not, therefore have served as a foot-path for animals between Africa and Spain (or *vice versa*) during the Quaternary. It is equally clear, however, that this narrow strait could not have presented any serious difficulty for the migrations of human groups and cultures. In fact, it is generally admitted that it was across the waters of Gibraltar that the Palaeolithic culture contacts between Africa and Europe (in both directions) were established [2]. We need not therefore elaborate this point any further.

THE SAHARO-ARABIAN BELT. L. PALAEOLITHIC CULTURES AND CHRONOLOGY.

N. W. AFRICA AND THE GREAT SAHARA.

The Saharo-Arabian Belt constitutes another important zone in the distribution of the L. Palaeolithic cultures. As may be seen from Map 1 (Pl. I), this region has yielded all the stages of the L. Palaeol. industries from the primitive-Chellean onwards. Taken as a whole, these stages resemble in their technique those of W. Europe; but unfortunately we have little or no *direct* evidence, on which to argue that the two culture-sequences were absolutely identical in their chronological order. The generally approved probability, however, is that this has been the case. As to the absolute chronology, on the other hand, the matter remains undecided. All that is known with certainty (or rather semi-certainty) is that the lowest stages of the Palaeolithic were at least as old in N. Africa as they were in W. Europe. Unfortunately, there are

[1] *Vide supra,* Part I, footnote 4, on p. 47; also R. Vaufrey (1929 *a*), footnote 1 on p. 19. On a probable late Pliocene connection between N. Africa and Spain see P. Pallary (1921), pp. 248-250; (1923), pp. 289-290.

[2] It may be broadly stated that the L. Palaeolithic spread from Africa into W. Europe while the Mousterian seems to have spread in the opposite direction. In the Up. Palaeol. most of Spain and parts of N. W. Africa formed one culture-province.

not enough physiographic data from the various parts of the Saharo-Arabian Belt, on which to form a definite opinion as to the exact place of the various stages of the L. Palaeolithic culture within the Diluvium. We shall find, however, that on the whole, such a dating of the cultures of this region may not be entirely impracticable if we bear in mind the cycles of climatic, faunal, vegetational and physiographic changes worked out in the preceding Part of the present work.

We need not go here into the details of the distribution of the L. Palaeolithic industries over the Saharo-Arabian Belt, with its innumerable surface finds. Suffice it to indicate some of the places where the industries were found *in situ,* and to attempt from these to date the sub-phases of the L. Palaeol. culture. So far as N. W. Africa is concerned it appears that its Lower Palaeol. started with the Chellean [1]. No cruder pebble-artifacts have as yet been found, though a more thorough investigation of the Early Diluvial terraces may still yield such implements [2]. It is interesting, however, that some of the crude artifacts worked from pebbles (and in some cases having a roughly shaped triangular cross-section) have been found in profusion on the surface of some of the Quaternary alluvia in the Wadi Mellegue, near Tebessa [3]. These implements may represent a very early Chellean or a Pre-Chellean culture [4]. Implements belonging to the Chellean proper have also been found *in situ* (though sometimes in disturbed layers) at Palikao (near Mascara), Gafsa, etc. [5]. We have

[1] For a good account of the L. Palaeol. of this region see, H. Breuil (1931), pp. 61-63; also H. Obermaier (1930), pp. 256-261.

[2] This newly differentiated type of crude pebble-implements is very difficult to recognise except by expert technologists, and it may have thus been easily missed by the ordinary searchers.

[3] See Collection of the Institut de Paléontologie humaine, Paris, two pieces registered as Bir S'baikia, Algérie, 1919-3. These specimens are similar to ones (also in same collection) from the 60 m. terrace of the Up. Garonne and which Breuil considers as very early Chellean or Pre-Chellean. Such implements also occur in Spain, Egypt and Syria (in Egypt, they are definitely either Early Chellean or Pre-Chellean, though similar tools occur in more recent levels, *vide infra,* p. 182). They should not be mixed with the so-called «Chalossian», as in fact their trihedral cross-section is largely due to the fact that they are worked of pebbles with a shape which lends itself to that particular form.

[4] For the possibility of the existence of such a Pre-Chellean culture *in situ* at Gafsa, see H. Obermaier (1930), p. 261.

[5] See H. Obermaier (1930), pp. 259-261, and H. Breuil (1931), p. 62.

already seen (*vide supra,* Part I, p. 66, and references in footnotes) that the Chellean fauna (best represented at Palikao) included both Sub-Equatorial and Eurasiatic species (some appearing for the first time). The flourishing in N. W. Africa of such warmth- and water-loving types as the Hippopotamus, and the appearance of new ones as the *Bubalus boselaphus* indicate that pluvial conditions in this region were accompanied by a sufficiently high temperature (presumably higher than to-day). On the other hand, the appearance of some of the Eurasiatic types (*e.g.* deer, bear, etc.) indicates that during the same Chellean phase (of N. W. Africa) there was also a westward spreading of Asiatic fauna. If is interesting to note that, with the introduction of these animals, half the total number of the N. African fauna was shared with that of W. Europe, during the same cultural phase (Chellean) of the latter region [1]. Of course, it may be argued that the spreading of S. W. Asiatic (and also Southern) fauna into Europe during the Chellean phase of that Continent took place at a different period (and for different reasons) from that of partly similar fauna into N.W. Africa (during its own Chellean phase). In other words, the Chellean may not have been contemporary in the two regions. It is clear, however, that the northward and northwestward migrations of the Southern and S. W. Asiatic fauna could hardly have taken place during anything but a warm Interglacial. If the conclusions arrived at by the great majority of workers in Europe (who differ on many other chronological points) be accepted, the Chellean there may be reasonably placed in the Mindel-Riss (compare Table XIII), which indeed provides such a warm Interglacial. As to N. W. Africa, we have just mentioned that the Chellean must have coïncided with a warm-wet phase. If the remarks made in Part I be regarded as plausible, this warm phase would correspond to the middle part of the 1st Pluvial—which we also equated with the Mindel-Riss of Europe (*vide supra,* Table XII). In this respect, it is interesting to note that, working on different lines of approach, certain N. African workers have attributed the Chellean in that region to the equivalent of the Tyrrhenian phase of the Mediterranean [3]. According to the scheme we worked out in

[1] See A. S. Romer (1928), p. 128 ; also *vide supra,* Part I, footnote 2 on p. 66.

[2] See L. Joleaud (1933), pp. 29-31 ; and reference in A. S. Romer (1928), p. 85. Also compare with our footnote 1 on p. 66 of Part I, *supra.*

Part I, this warm phase of the Mediterranean (with *Strombus bubonius*) also corresponded to the M.-R. Interglacial [1]. In other words, it may be safely concluded that in spite of the absence of any direct physiographic evidence, the Chellean of N. W. Africa belonged to the same phase as that of N. W. Europe—*i. e.,* the M.-R. Interglacial.

The Acheulean of the N.W. Africa cannot be so clearly dated as the Chellean [2]. As a good deal of the fauna of the Chellean seems to have survived through this phase, however, it may perhaps be taken for granted that it partly occupied at least the remaining part of the 1st Pluvial (after the passing of the Chellean) [3]. It is also very probable that the Acheulean continued to flourish in certain favourable parts of this region during the Interpluvial which separated the 1st from the 2nd Pluvial (*i.e.,* during the equivalent of the Riss-Würm). We know from the section at the Gafsa deposits that the Up. Acheulean continued till just before the appearance of the Mousterian, from which it was separated by slight land movements [4]. R. Vaufrey places these movements towards the close of the R.-W., and we have already put forward the data in support of this assumption [5].

Another interesting feature of the Acheulean of N. W. Africa is its probable survival (in Mid. Palaeol. times) in the form of the industry known as the S'baikian [6]. This industry is exclusively made up of very crudely

[1] It may be remembered that this phase was characterized by increased temperature both in the air and in the waters of the seas. This meant increased evaporation, air circulation and rainfall. Also the tracts of storms and depressions became less defined, so that these latter reached regions which would have otherwise remained almost entirely rainless.

[2] On the Acheulean industry and fauna of Lake Karar (*in situ*), see M. Boule (1900), pp. 1-21 ; also H. Obermaier (1930), p. 259 and H. Breuil (1931), p. 62.

[3] Of course the climate may have become less warm during the Acheulean than it was during the Chellean, but the change was not large enough to lead to the extinction or the emigration of the fauna.

[4] See R. Vaufrey (1932), p. 319 ; (1933), p. 92.

[5] It may be remembered that the equivalent of the R.-W. Interglacial was marked by fairly extensive land-movements in the Mediterranean, certain parts of the Saharo-Arabian Belt, East Africa, the Himalayas, etc.

[6] See M. Reygasse (1922), pp. 163-167 ; also collection of the Institut de Paléontologie humaine, Paris, specimens regist. : El-Ouesra E. 1920.5 and E. 1922.21 and S'baikian E. 1932.5 ; also coll. of Brit. Mus., London, specimens regist. : Reygasse 1925, 10.21, Nos 9-39. At first,

shaped laurel-leaves which Reygasse thinks have been derived directly from the Acheulean *coup-de-poing*. The leaves are much cruder than either the classical points of the Solutrean of Europe or those of the Neolithic of Egypt and parts of the Sahara. The fact that certain more or less similar leaves occur in the Acheulean of N. W. Europe [1] may perhaps render it plausible that the S'baikian is a true and direct derivative of the Acheulean. It should be made clear, however, that all the finds thus far available of this industry come from the surface (of the region of el-Ouesra), and that, consequently, its exact status and chronological place cannot be regarded as definitely proven. While therefore not denying the possibility of a S'baikian level in late- and post-Acheulean times, we prefer to follow Breuil in maintaining an open mind on this question [2].

As is the case in N. W. Europe, the *coup-de-poing* industries of the L. Palaeol. in N. W. Africa were associated with flake cultures belonging both to the Clactonian and the Levalloisian [3]. The latter of these appears to have continued into the Middle Palaeolithic until its place was finally taken by the true Mousterian and the Atirian (Aterian). The story of the Mid. Palaeolithic, however, must be deferred for further consideration at a later stage.

The interior of the Sahara is still very little known. Surface finds have been reported from various parts, especially the Algerian Sahara, the W. borders of the C. and S. C. Massifs, the W. plains of the Sahara and the Tibesti

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M. Reygasse (1921, pp. 527-531) suggested that the S'baikian might represent a link between the Acheulean and the Solutrean; but later on (1922, pp. 163-167), he became more reserved about such a daring assumption. We shall see in Section II that the Solutrean of Europe had nothing to do with Africa.

[1] *e. g.* Coll. of the Inst. Paléont. hum., Paris, specimens reg. : Abbeville E. 1926.17; St. Acheul E. 1922.8 (coll. d'Ault); and Menchecourt E. 1924.25.

[2] H. Breuil; verbal information kindly given by him. Other authorities, however (*e.g.* H. Obermaier, 1930, pp. 257-258, and O. Menghin, 1931, p. 115), seem to accept this industry as an established culture (representing a cultural phase).

[3] See H. Breuil (1931), p. 62-63. It seems that the industry which E. Koken (1909, p. 15), describes as Mesvinian at Gafsa is nothing but a Clactonian facies occuring below the Chelleo-Acheulean (or Early Ach.) level. Whether the Levalloisian was autochthonous with the Acheulean in N. W. Africa and the Sahara, or whether it was introduced from without, remains an open question; *vide infra*.

region. These are usually miscellaneous finds including roughly all the core- and flake-facies of the L. Palaeolithic [1]. It is interesting to note, however, that in spite of search (though only on a limited scale), no L. Palaeolithic implements have thus far been discovered in the higher part of the C. Massif of Hoggar (apart from Tassili area) [2]. This may be regarded as a negative fact which could perhaps be disproved by a more thorough search; but it seems that even if they should turn up from this region, the L. Palaeolithic implements would not prove to be plentiful. Indeed it is reasonable to infer that, on the whole, the human groups of the L. Palaeolithic preferred the slopes and the lower valleys to the top-lands of the C. Massif. This may serve to indicate that even at the height of the pluvial phases the rainfall was just enough to maintain the semi-running streams—thus forcing man and game to concentrate round the watering places on the lower slopes and at the bottom of the valleys. We have also seen (*vide supra,* Part I, footnote 2 on p. 75) that a similar state of things prevailed during the Early Neolithic (of the region) when human settlements seem to have been more or less limited to the *zones d'épandage* and the bottom of the valleys, where water was readily available. Only in protohistoric and historic times (of the region) did man "go up" to the top-lands, after he became equipped with methods of well-digging, etc. This is perhaps the most plausible explanation of the peculiar distribution of prehistoric finds in this part of the Sahara [3].

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[1] Of special interest in the W. Sahara are the rough cleavers, made of side-blow flakes (of which the bulb has sometimes been removed by inverse trimming). See H. Breuil (1931), fig. 9 on p. 64, where this author calls them *hachereaux sur éclats levallois*. A. H. Goodwin (1933 *a*, pp. 111-118, 122-123) has suggested a certain relation between the technique of these implements (which he calls the «Tachenghit technique») and the «Victoria West technique» of S. Africa (also side-blow flakes). His correlations are purely typological, but they may not be without justification. The Tachenghit cleavers may be roughly regarded as Acheuleo-Levalloisian (or perhaps later). We way further note that C. van Riet Lowe (1937, pp. 110, 113), considers this technique of side-blow flakes as perhaps representing a Proto-Levalloisian stage. This would be useful to bear in mind when we come to consider the origin and dispersal of the Levalloisian technique (*vide infra,* close the present Section).

[2] See reference in Th. Monod (1932), pp. 141-142.

[3] We should note, however, that an expedition to the Tibesti Massif has discovered many sites belonging to the L. Palaeolithic (M. Dalloni, 1935, pp. 93-97 and Figs. 20-29). Most of the

The chronological place of the L. Palaeolithic facies of the interior of the Sahara remains a matter of guess-work. An approximate idea may be gained by comparison with N. W. Africa as referred to in a preceding paragraph.

To the S. of the Sahara, very little is known about the cultures and their date. So far as we know, the L. (and perhaps also the true Mid.) Palaeolithic have turned up only from the region of the Jos Plateau in N. Nigeria [1]. The large implements found there may be roughly attributed to a Chelleo-Acheulean phase, while some of the lighter flakes may be termed Levalloisian or perhaps even Mousterian [2]. Unfortunately, the implements are much too rolled and mixed up to give definite or even relative date. As they occur at the base of the alluvium of the 2nd Pluvial (equivalent of Würm), however, it may be suggested that they belonged (at least in part) either to the preceding Interpluvial (R.-W.) or to the close of the 1st Pluvial.

If we may now summarize the story of the L. Palaeolithic of the W. part of the Saharo-Arabian Belt in general, it may roughly be stated that the Early (or primitive-) and the typical Chellean (with Clactonian) were fairly well represented and may be attributed to the Middle part of the 1st Pluvial (*i. e.* the equivalent of the M.-R. Interglacial and the retreat and advance phases of the M. and the R. respectively). The Chelleo-Acheulean and Acheulean (with Clactonian and Levalloisian) were also widely represented, and may be placed in the latter part of the same Pluvial (*i. e.* the equivalent of R.) together with the following Interpluvial (when the cultures became limited to favourable

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sites were in valleys and torrential beds at the flanks of the highlands, but some of them also occured at relatively high levels (1350 m.) in interior parts of the massif.

[1] See H. J. Braunholtz (1926), pp. 3-7; H. Balfour (1934), pp. 21-24, and Figs. 1-3; also reference in H. Breuil (1931), p. 63.

[2] An interesting *coup-de-poing* type is the one represented by plano-convex pieces (with the flat face being sometimes due to a natural fracture surface which is left more or less intact); see H. J. Braunholtz (1926), p. 6 and Figs. 1 and 2. This type is found sporadically in N.W. Europe (late Ach.) but is abundant in E. and S. Africa (Acheulean). On types from E. Africa, see L. S. B. Leakey (1931), photos 1 and 2 on Pl. IV, also Figs. 3 and 5. It also occurs in N.W. Africa; see H. Breuil (1931), Fig. 3 on p. 62, where he regards the associated industry as Chellean. Interestingly enough, partly similar sporadic specimens have recently been discovered in the Up. Acheulean of the Khargah Oasis [*e.g.* specimen N° 58060 (Caton-Thompson, 1931-1932, K. O. 10A. 108), in Coll. of the Egyptian Museum, Cairo; also *vide infra,* p. 190].

areas only). Whether the Acheulean (in this region) continued into the early part of the 2nd Pluvial is not clear, though it is probable that some form of it (or perhaps a derivative like the S'baikian?) may have persisted well into Middle Palaeolithic times. The Middle Palaeolithic proper (Mousterian) certainly belonged to the maximum (or 1st sub-maximum?) of the 2nd Pluvial; but its discussion must be deferred to a later stage.

N. E. AFRICA (AND PALESTINE). THE L. PALAEOLITHIC OF EGYPT; ITS MORPHOLOGY, STRATIGRAPHY AND CHRONOLOGY.

We must now pass on to N. E. Africa. Unfortunately, hardly anything is known about the L. Palaeolithic of Tripolitanian Libya, which must, therefore, be left aside [1]. On the other hand, abundant surface and *in situ* finds of this age have been made in Egypt proper. The surface specimens are found either in the valley itself or in the W. and E. Deserts [2]. It would of course serve no practical purpose to survey the distribution of these surface finds (indicated very broadly on Map 1, Pl. I). Suffice it to point out that they cover practically all the known stages of the L. Palaeolithic [3]. The dating of the facies they represent could be made possible only through the help of finds *in situ*. Fortunately, large series of these latter have come to light in recent years thanks to investigations by P. Bovier-Lapierre, Sandford and Arkell and more recently, Caton-Thompson and Gardner [4], whose works we shall now briefly discuss in turn.

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[1] A. Desio (1929, pp. 2-4 and Tav. I-II) mentions the existence of so-called «pseudo-eoliths»; but from his accounts and drawings the specimens in question are either ordinary chips (mostly natural) or — in one case — a core of Up. or Final Palaeol. facies.

[2] For general accounts mostly based on surface finds, see C. G. Seligman (1921), pp. 115-153; P. Bovier-Lapierre (1929), pp. 33-44; (1930), pp. 121-128 and (1931), pp. 18-25; also F. H. Sterns (1917), and C. T. Currelly (1913).

[3] The doubts expressed by certain authorities as H. O. Forbes (1900), pp. 114-115, as to the authenticity of the palaeolithic nature of these finds can no longer be entertained.

[4] For accounts on these *in situ* finds, see P. Bovier-Lapierre (1931), pp. 25-26; (1925), pp. 37-46; (1926*a*), pp. 299-301; (1926*b*), pp. 257-275; and K.S. Sandford and W. J. Arkell (1928*b*), pp. 18-27; (1929), pp. 65-69; (1929*d*), pp. 28-34; (1933), pp. 72-81; (1939), pp. 95-98; and K. S. Sandford (1934), pp. 109-119; and G. Caton-Thompson

The ʿAbbasyyah Plain.

The first of these workers found a series of implementiferrous Beds in the Southern group of the gravel-pits in ʿAbbasyyah, just outside Cairo. According to his accounts (which have been only inadequately published), the following levels may be distinguished from below upwards [1] : (compare also with our Pl. VI, Figs. A and C) :

Level II. From 20-10 m. below surface : sterile Bed of marine or estuarine sands.

Level I. From 10 m. below surface—to the surface : implementiferrous Beds of gravels and sands arranged as follows :

D 10-5 m. : with implements of an Early or Pre-Chellean technique. These include a series of crudely shaped implements, with trihedral cross-section, which the author had at one time considered as belonging to the so-called "Chalossian" [2] (Pl. VII, 1-2).

C 5-2 m. : with true Chellean (and Chelleo-Acheulean) pieces, but no specimens of the trihedral type.

B 2-0 m. : with Acheulean specimens occurring up to the surface.

A On the surface, the Micoquian types are found mixed with a so-called "Mousterian".

From a brief study of the collection of this author [3], the following remarks may be made on his conclusions (compare also our Pls. VI-VII) :

(1) In the first place, we have already seen (*vide supra* footnote 4 on p. 166) that the question of a "Chalossian" technique can no longer be entertained; and it is significant that Bovier-Lapierre himself

(1931 *a*), pp. 77-84; (1931 *b*), pp. 221-226; (1932), pp. 129-135 and G. Caton-Thompson and E. W. Gardner (1932 *a*), pp. 383-404. See also earlier accounts by G. Schweinfurth (1903), (1904), (1905) and (1909); also M. Blanckenhorn (1921 *a*), pp. 35-38.

[1] A note on the ʿAbbasyyah pits and their physiography and implements may be also found in K. S. Sandford and W. J. Arkell (1939), pp. 51-53, and Fig. 13.

[2] P. Bovier-Lapierre (1925), pp. 40-41 and (1926 *b*), pp. 271-272. The use of the term «Chalossian» for Egypt and Syria was first made by E. Passemard (1924).

[3] By his kind permission.

(verbal information) no longer inclines to use this term for his ʿAbbasyyah specimens. The trihedral cross-section of these implements may be largely due to the fact that they were made of elongated (and not globular) pebbles, whose original shape dictated the ultimate form of the finished piece. None-the-less it is interesting that this industry occurs at a lower level than the Chellean proper, which justifies its being regarded as Pre-Chellean or primitive-Chellean.

(2) As we shall presently mention, the same Pre-Chellean level has also yielded a crude clactonian-like pebble industry, which also continues (with some Clactonian flakes) into the Chellean and Chelleo-Acheulean level. The nature of this facies seems to have been largely overlooked by Bovier-Lapierre. Its value in the culture-sequence of the L. Palaeolithic of N. E. Africa will be seen later on in the present Section.

(3) And finally it may be added that the use of the term "Mousterian" for the surface finds cannot be accepted. These specimens are largely made up of tortoise cores, and broad and narrow simple flakes. Usually the flakes have a prepared striking platform; but never (or hardly ever) do we find the typical marginal retouching of the true Mousterian. We therefore prefer to designate this industry as Levalloisian rather than Mousterian [1]. This point will be returned to when we come to deal with the Mid. Palaeolithic of Egypt.

Further light may be thrown on the conclusions of Bovier-Lapierre by their comparison with those arrived at by Statham in a study of the Northern group of the gravel pits of the ʿAbbasyyah Plain. This latter group of pits has the advantage over the Southern one (studied by Bovier-Lapierre) in having exceptionally thick implementiferrous Beds (twice as thick as the Southern group according to Statham; also compare Figs. A and B on our Pl. VI). According to Statham's notes on the Beds and their implements [2], the following series of levels may be established (Fig. B on Pl. VI, from below upwards) :

[1] An attempt to subdivide and trace the ancestory of the various flake facies of the L. and Mid. Palaeol. in general is given in H. Breuil (1932), p. 127.

[2] Unpublished field-notes given with his collection to the Geogr. Dept., Faculty of Arts, Fuad I University, Gizah, Cairo. (Compare also our Pls. VI, 1, VII, 1-3 and VIII, 1.)

Level IV. At about 20 m. from surface. A Pre-Chellean, so-called "eolithic" industry.

Level III. At about 17-15 m. from surface. Chellean and trihedral forms.

Level II. At 15-8 m. from surface. Chellean and Acheulean.

Levels I *a* and I. Just below surface and on surface. Advanced Acheulean and so-called "Mousterian".

From a study of his material (Geography Dept., Fuad I University, Cairo; *vide* Pls. VI-VII) it was found that apart from some interesting pebble specimens, his so-called "eolithic" level is largely doubful. His Chellean and Acheulean industries are not sufficiently clear, as unfortunately the typical specimens of these two facies were very rare. There are, however, a number of specimens which may be termed as Pre-Chellean or primitive-Chellean. But the main interest of Statham's collection lies in the crude Clactonian-like core artifacts to which reference has just been made (Pl. VI). These implements occur very sporadically in level IV, but they become quite abundant in levels III and II. In level I, they seem to disappear again. On the physiographic evidence, therefore, they may be correlated with the Pre-Chellean, Chellean and Chelleo-Acheulean levels of Bovier-Lapierre. As may be seen from illustrations on Plate VI, the pebbles of 'Abbasyyah are shaped by means of alternate chipping (*coups alternatifs*) on both faces, which gives them a zig-zag cutting edge. The butt-end is invariably left with the original smooth surface, which may perhaps suggest that they were used as choppers or throwing stones (?). Judging by the cavities of the chipping, and also by the chips found associated with the pebbles, it is evident that the great majority of chips could hardly have been put to any practical use. They are small, broad waste-chips which retain the original crust-surface of the pebble on one of their faces, and show no traces whatever of utilization. Only very few specimens of true Clactonian flake-artifacts have been found in the vast collections of Bovier-Lapierre and Statham [1]. This shows that it was the pebble (core) artifact and not the flake that was aimed at in this industry [2]. Yet the striking technological similarity between the pebbles of 'Abbasyyah and those found

[1] Even these very few flakes that were found in the collections of Statham and Bovier-Lapierre may be regarded as only of Clactonian-like appearance.

[2] As far as we could judge from a hasty examination (at Cambridge and London) of similar pebble implements discovered by L. S. B. Leakey in E. Africa (and to which reference will be made in due course), it seems that, in many respects the two industries are almost absolutely identical. We do not know whether this "pebble industry" of E. Africa were accompanied by any flakes. A Clactonian-like facies of flakes, however, seems to exist (sporadically) in S. Africa; see C. van Riet Lowe (1937), p. 111.

in definite Clactonian levels in W. Europe cannot be overlooked [1]. It appears that the main difference between the two regions is that whereas in Egypt [2] (and also in E. Africa, *vide infra*) the pebble specimens are predominant, the position is almost the reverse in W. Europe. Whether, therefore, the term Clactonian could be justly used for this Egyptian (and E. African) facies is a matter that must be left until more material is available from the intermediate regions [3]. At any rate, it should be kept in mind hat while in Egypt (and E. Africa) the pebble facies makes its first appearance at a lower level than the Chellean [4], the L. Clactonian of W. Europe is associated, on physiographic evidence, with the Chellean phase proper (*vide supra,* Table XIII).

[1] Compare illustrations on our Pl. VI with H. Breuil (1932), Fig. 1, Nos. 1 and 4 and Fig. 4, Nos. 23-26; see also *ibid.*, pp. 135, 141 and 145 where reference is also made to this type of pebble nucleus.

[2] We have been able to trace this pebble technique in other parts of Egypt both *in situ* and among surface finds. For specimens which were presumably found *in situ* (though perhaps in a derived state) in Up. Egypt see coll. of al-Mat-haf al-Misri (Egyptian Museum, Cairo), pieces regist. 52147, 54223, 54231 and 54236 (all Sandford). For surface specimens, mostly from N. Middle Egypt and confines of Delta, see coll. of same museum (pieces not registered); also coll. of Deutsches Inst. f. aegypt. Altertumskunde (Cairo), two specimens marked as *"Ostdeltareise";* also specimens in O. Menghin's coll. (Vienna). These surface specimens, however, are of uncertain date, and may be very much later than those found *in situ* at 'Abbasyyah; *vide* also *infra,* footnote 4, below.

[3] Let us for the moment use the designation Clactonian-like? In E. Africa, the term "Kafuan" has now been introduced.

[4] So far as we can gather, the pebble industry of E. Africa seems to lead into the L. Chellean (see L. S. B. Leakey, 1936, p. 41; also reference in C. van Riet Lowe, 1937, p. 76). In Egypt, it continues into the Chellean and Chelleo-Acheulean phases (and recurs very much later). A possible link between the pebble stage and the Chellean proper is provided by the trihedral (and other) specimens of the Pre-Chellean (worked of pebbles; *vide supra* and our Pl. VII). It is possible that the survival (and recurrence) of the pebble implements in Egypt may have been largely due to the great abundance of pebbles that lend themselves particularly to this technique. We should further add, however, that the date of surface specimens from Egypt cannot be fixed with any certainty. Pebble tools similar to these Clactonian-like ones, as well as other types of

The Implementiferrous Terraces of the L. Nile Valley.

It may be gathered from the preceding account of 'Abbasyyah, that the interest of its implementiferrous formations lies in their value for the technological sequence of cultures rather than for *absolute* chronology. For the chronology of Egyptian cultures we are indebted to other workers especially Sandford (and Arkell) in the Nile Valley and Caton-Thompson and Gardner in the Khargah Oasis. As may be recalled (from Appendix A, Part I), K. S. Sandford and W. J. Arkell have greatly contributed to our knowledge of the physiography and prehistoric archaeology of the Nile Valley by discerning a series of implementiferrous terraces in it. These may be briefly stated as follows [1] :

30 m. terrace : with Early (or primitive) Chellean, Chellean and Chelleo-Acheulean (the latter being in the so-called 30-17 m. gravels). The specimens are rolled and unrolled. Many specimens are worked of pebbles and some have a trihedral cross-section. Also few Clactonian flakes (so-called "Egyptian Clactonian").

17-15 m. terrace : with Acheulean (unrolled) and Chellean (rolled). Also some rather crude flakes.

10-8 (or 9) m. terrace : with very scarce so-called "Early Mousterian" implements.

3 m. terrace : with abundant so-called "Mousterian".

We have already seen (in the above-mentioned Appendix), however, that Sandford and Arkell make relatively little attempt to fix the chronological place of their terraces within the Quaternary [2]. Not only are their palaeontological finds (which might have been of some help for dating purposes) extremely scarce and

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Palaeolithic-like tool-cores are known to have been used in Egypt in late prehistoric (and even early historic) times. The survival—or rather the re-invention—of Palaeolithic-like tools in Neolithic and Post-Neolithic Egypt has often led to complexities and misinterpretations amongst workers. See reference in S. A. Huzayyin (1937), pp. 226-227 and Pl. LVIII, No. 42 ; also G. Caton-Thompson, E. W. Gardner and S. A. Huzayyin (1936-1937), pp. 292 and 294 and Pl. V, Nos. 3-4.

[1] See particularly K. S. Sandford and W. J. Arkell (1933), p. 86 (also other references in our footnote 4 on p. 181).

[2] See K. S. Sandford (1934), p. 52 and K. S. Sandford and W. J. Arkell (1939), Fig. 9 and p. 98. Sandford equates the 30 metres and 17-15 m. terraces with the Tyrrhenian (30 m.)

fragmentary, but also these authors do not admit the existence of any climatic sub-divisions within the Pluvial Peroid. Unfortunately also their archaeological classifications may not be easy to accept as they stand. It appears that although they occur abundantly in some of the terraces, the number of implements actually found *in situ* in others (*e.g.*, the 9 m. terrace) is not large enough even to justify speaking of a definite archaeological level. Furthermore, it should be remembered that however abundant they may be, the series of implements discovered in the terraces of the Nile can in no way represent the whole of the technological sequence of the L. and Mid. Palaeol. of Egypt; as the phases of river erosion and bed cutting are hardly represented at all [1]. In spite of all these handicaps, and of the absence of any detailed comparative study of the material, however, the following general remarks may be made on the archaeological classifications as worked out by Sandford [2] :

(1) Taken as a whole the industries of the 30 m. terrace may be largely accepted as classified by Sandford. Of particular interest is the fact that he prefers to speak of his trihedral specimens (with trihedral cross-section) as Early or primitive-Chellean rather than Chalossian [3]. He also distinguishes an "Egyptian Clactonian" facies, characterised not only by its flakes (relatively few ?) but more especially by its cores [4]. In this respect, it should be recalled that isolated flakes with a Clactonian fracture (*i. e.* high angle of striking platform and detached bulb) occur

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and Monastirian (18 m.) stages of the Mediterranean. This is a fairly reasonable equation, but the author does not put forward the reasons on which it is based, while no raised beaches are known from the N. coasts of Egypt.

[1] This criticism applies particularly to such rivers as the Nile, where valley formations are entirely governed by fluviatile activity (in its relation to changes both in rainfall and in base-level). In other valleys (like those of N. France), however, there are æolian lateral formations (loess) containing series of implements which supplement those found in the fluviatile deposits of the terraces proper.

[2] These remarks are based on a study of the publications available together with the small series of implements in the Cairo Mus. (which is representative only of the pebble group of implements). A comparative study of the main body of Sandford's coll. (now largely in the Geol. Mus., Oxford ?) with other Egyptian and Palestinian material is still a *desideratum*.

[3] K. S. Sandford and W. J. Arkell (1933), p. 73.

[4] Sandford and Arkell (1933), p. 74 and Pls. XVI, 5 and XVII, 6.

in all archaeological levels from the L. Palaeolithic to the Neolithic and later; and that, consequently, unless such flakes occur in sufficiently large series they do not warrant speaking of a "Clactonian" facies of flakes. On the other hand, we have seen that the distinctive feature of the "Clactonian-like" industry (if we may use the designation) of Egypt, are the crude pebble artifacts (cores) and *not* the flakes [1]. These pebbles occur in exceptionally large numbers and their stratigraphical place as an archaeological facies can hardly be open to doubt.

(2) The industry of the 17-15 m. terrace is placed by Sandford in the Acheulean generally [2]. It would be interesting, however, to define its exact place within that culture phase. So far as we can judge the facies of this terrace can best be regarded as of a Middle (and a very advanced Lower?) Acheulean type [3]. At any rate it is evidently more archaïc than the fine Up. Acheulean facies more recently discovered in Khargah and Palestine (*vide infra*) [4]. The fact that in Khargah (and perhaps also in Palestine?) the Up. Acheulean facies could be dated in its relation to climate (advance phase of the 2nd Pluvial) helps (though only indirectly), to fix an uppermost dating limit for the 17 m. terrace of the Nile.

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[1] It may be noted, however, that H. Breuil (1931, p. 63 and Fig. 13) considers that some of the flakes found *in situ* (or in a derived state) by G. Schweinfurth near Thebes may be *apparentés au Clactonien*. This may be true of a few (perhaps only one or two) specimens in the Coll. of the Institut de Paléont. hum. (Paris). But a study of the larger part of Schweinfurth's collection (now at the Afrik. Abt. of the Völkerkunde Mus., Berlin), has shown that perhaps only one specimen of the coll. (regist. III A. 3331) may be regarded as having Clactonian affinities. The rest we believe to be perfectly natural flakes (and nodules).

[2] In one of his publications, however, this author (Sandford, 1934, pp. 112-114) regards the industry of this terrace as a highly evolved Acheulean. From a comparison of the implements he figures with those from Khargah and Palestine (which are definitely Up. Acheulean) we are unable to accept this classification without reserve. Taken as a whole, his implements differ somewhat in form and technique from the true Up. Acheulean of this part of the Old World.

[3] According to Breuil's classifications for W. Europe the "limandes" of this terrace may perhaps be regarded as Ach. II, and its "lanceolates" as Ach. III-V. The danger of an unreserved application of such a detailed classification on a world-wide scale, however, should not be overlooked.

[4] Sandford himself thinks that in spite of the existence of some pointed *coups-de-poing*, these do not justify speaking of a Micoque facies in this level (see Sandford and Arkell, 1933, p. 75).

(3) The industries of the two lower terraces (9 m. and 3 m.) belong to the Mid. Palaeolithic with which we shall deal at a later stage. Suffice it, for the moment, to point out that, apart from the flakes which Sandford regards as "Mousterian", they include finely finished *coups-de-poing*, which could be regarded as of a very advanced Acheulean or a Combe Capelle technique [1]. Indeed, these implements together with the associated flakes, make it possible to correlate the 9 m. and 3 m. terraces of the Nile roughly with the Acheulean (Uppermost)-Levalloisian phase of the Khargah Oasis (*vide infra*) [2].

As we have just mentioned, Sandford and Arkell largely refrain from fixing the approximate date of their terraces within the Diluvium. We have attempted, on the other hand, to provide a *tentative* system of dating for these terraces, based largely on the evidence of the changes of the sea level, on the one hand, and the climatic conditions, on the other (*vide supra* Appendix A, Part I). If the conclusions arrived at there be accepted, it would mean that the 30 m. terrace (with its Pre-Chellean, Chellean and Chelleo-Acheulean) may be placed in the middle part of the 1st Pluvial (*i. e.* Mindel-Riss Interglacial together with the retreat and advance phases of the Mindel and the Riss respectively); the 17-15 m. terrace [with its advanced Lower (?) and Middle Acheulean] in the closing stages of the same Pluvial (*i. e.* retreat phase of Riss, together with the opening stages of Riss Würm Interglacial); the 9 m. terrace (with its early Mid. Palaeolithic and perhaps also late Acheulean) in the advance phase of the 2nd Pluvial (*i. e.* advance of Würm I and II taken together) and finally the 3 m. terrace (with its true Mid. Palaeol.) in the middle part of the 2nd Pluvial (*i. e.* the inter-maximal stage between Würm I and II on the one hand, and Bühl on the other). Interestingly enough this conclusion, arrived at separately (on physiographic grounds) gives the L. and Mid. Palaeolithic in Egypt a system of dating which agrees, in a remarkable degree, with that we have already seen in N. W. Africa (also *vide infra* Tables XIV and XVI).

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[1] For such specimens see Sandford and Arkell (1933), Pls. XXVIII (and XIX?).

[2] Though of course the chronological place of the 9 m. terrace is still undecided owing to the scarcity of material from it.

The Khargah Oasis.

One of the most recent contributions to Egyptian Palaeolithic is that of Caton-Thompson and Gardner. Their work in the Khargah Oasis adds to our knowledge of the technological evolution and the chronology of the late-Lower and the Mid. Palaeol. of this region [1]. Unfortunately, however, their finds *in situ* do not seem to go farther back than the Up. Acheulean. Earlier facies are found only on the surface (or in profusion on the surface?) and could not be dated with any certainty. The earliest dated industry (Up. Acheulean) includes a few (two or three) implements with plano-convex cross-section and of a (surviving) Mid. Acheulean appearance (*vide supra* footnote 2, on p. 180; and our Pl. VIII, 2); but the bulk of its implements are decidedly of an evolved (Up.) Acheulean facies (see our Pl. IX, 1). The *coups-de-poing* are mostly of cordiform and lanceolate types, though in some cases they retain the original butt of the nodule of which they were made. A comparative study of this industry and the Up. Acheulean of Palestine (especially that of the Umm Qatafa Cave) reveals a remarkable degree of similarity between the two [2]. Apart from ordinary similarities in the technique, the most characteristic (new) feature of the two industries is the *coup de burin* on some of the *coups-de-poing* [3]. So far as is known this is the earliest occurrence of the burin technique, and in all probability it corresponded to some technological connection between Egypt and Palestine. This may be strengthened by the fact that, as we shall see a little later, the two industries appeared about the same chronological phase.

After the Up. Acheulean of Khargah comes an Acheuleo-Levalloisian phase of rather mixed nature. Levalloisian affinities which were characteristically

[1] See G. Caton-Thompson and E. W. Gardner (1932 *a*), pp. 383-404 and forthcoming publication (probably a forthcoming memoir of the Institut d'Égypte?). Also G. Caton-Thompson (1931 *a*), pp. 77-84 and (1932), pp. 129-135. Also coll. of Cairo Museum.

[2] On the Up. Ach. of Umm (Um) Qatafa see R. Neuville (1931), pp. 23-51. For the Khargah, information kindly given by G. Caton-Thompson.

[3] *e.g.* specimen No. 6, Fig. 18 in R. Neuville (1931). In Palestine (but so far not in Khargah) the burin occurs also on ordinary flakes; *e.g.* Fig. 12, Nos. 1-3 and Fig. 18, Nos. 1-5 and 7 in R. Neuville (1931).

scarce in the Up. Acheulean [1] became more and more marked until they dominated. The industry, however, retained a fair number of *coups-de-poing* which appear to represent survivals into a late L. Palaeolithic or rather a Mid. Palaeolithic phase [2]. Another feature of the industry is that it no longer shows the resemblances to that of Palestine which marked the Up. Acheulean phase. Indeed, we seem to have here the beginnings and development of a Middle Palaeolithic phase which was gradually acquiring a predominantly local (Egyptian) facies, distinguishing it from those of Palestine and the W. Sahara (N. W. Africa). But this question will be further elaborated when we come to consider the Mid. Palaeolithic later on.

The chronological place of the Up. Acheulean and Acheuleo-Levalloisian of Khargah is fairly clear. According to physiographic data, the first of these coïncided with the advance phase of the 2nd Pluvial (or part of its first maximum), while the second covered the greater part of the same Pluvial (compare also with Diags. 4 A and B on Pl. V, and *vide supra* pp. 88-94). If the correlations put forward at the close of the preceding Part be accepted, the Up. Acheulean would be equated with the advance of Würm (together perhaps with the closing stages of the R.-W. Interglacial and part of the Würm I maximum?) and the Acheuleo-Levalloisian with the Würm (I and) II (taken together) and the Interstadial separating them from Bühl.

The L. Palaeolithic of Syria and Palestine.

Before we proceed to summarize the story of the L. Palaeolithic of N. E. Africa, a word must be said about this culture phase in Syria and Palestine. Unfortunately our knowledge about this region is still in its earliest stage.

[1] G. Caton-Thompson (1932), pp. 132-133. It may be useful to add here that although, in a general way, the L. Palaeol. cultures of the Old World yield both core (*coup-de-poing*) and flake tools, the proportion of these to each other is not the same in different regions. We have already seen that in the early pebble culture stage flakes were particularly scarce in Egypt, while they abounded (as a Clactonian facies) in other regions such as W. Europe. It is also possible, that the flake tools remained at first scarce in the Acheulean of Khargah (but apparently not Nile Valley) until later on, they became remarkably predominant and very highly specialized.

[2] G. Caton-Thompson prefers to include this phase in the L. Palaeolithic; but it seems equally admissible to place it at the base of the Mid. Palaeolithic proper.

The early L. Palaeol. is known only from surface sites [1]. Some of its implements are made of pebbles and have a trihedral cross-section—thus resembling the primitive-Chellean of 'Abbasyyah [2]. The crude Clactonian-like pebble artifacts, however, are still unknown from the region, though this may be disproved by further finds. A single specimen of evolved Chellean affinities was discovered *in situ* at the base of the gravels of the 27 m. terrace of the Euphrates [3]. If this terrace be regarded as more or less equivalent to the 30 m. Nile terrace, the Chellean of S. W. Asia would fall together with that of Egypt in the middle part of the 1st Pluvial. As to the Chelleo-Acheulean and the L. Acheulean, little is known about the technological character or chronological place of these phases. On the other hand, abundant evidence has been forthcoming in recent years from the Palestinian Caves relating to the Up. Ach. and Acheuleo-Mousterian phases [4]. The first of these bears marked resemblances with the corresponding culture in the Khargah Oasis (*supra*). Accepting theoretical correlations of past climates, however, Garrod equates the Up. Ach. of Palestine with retreat of Riss, its L. Mousterian with R.-W. and its Up. Moust. with Würm I [5]. But we have seen (*supra,* pp. 101-102) that Palestinian faunal evidence indicates a single (oscillating) Pluvial from Up. Ach. to end of Up. Palaeol. times. If our suggested correlations be accepted, this Pluvial would correspond to the phase from the close of R.-W. to the retreat of Bühl (inclusive). The Up. Ach. and Acheuleo-Mousterian of Palestine would thus fall in the close of R.-W. and the advance of Würm.

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[1] For general accounts on surface finds see M. Blanckenhorn (1921 *a*), pp. 39-48; P. Karge (1925), pp. 24-25; A. Mallon (1925), pp. 185-190; also H. Field (1929), pp. 35-37 and G. Clark (1933), pp. 147-149. Also H. Rhotert (1938).

[2] *e.g.* Coll. of Inst. Paléont. hum., Paris, regist. E. 1926-32. It was presumably the occurrence of this type that led E. Passemard (1927 *a*), p. 71 to speak of a "Chalossian" technique in Syria and Palestine.

[3] See E. Passemard (1926 *a*), p. 367.

[4] See especially R. Neuville (1931), pp. 23-51 and 249-253. F. Turville-Petre (1927), pp. 21-22; D. A. E. Garrod (1934 *b*), pp. 144-150 and Garrod and Bate (1937). It is to be noticed that whereas in Egypt there is an "Acheuleo-Levalloisian", in Palestine there is mostly an "Acheuleo-Mousterian" (but also with Levalloisian tradition). For technological differences between Levalloisian and Mousterian *vide infra* footnote 2 on p. 221.

[5] D. A. E. Garrod (1934 *b*), pp. 144-150 and Garrod and Bate, 1937; also reference in R. Vaufrey, 1939, p. 401 and 406, where criticism of her views is also given.

Summary of L. Palaeolithic in E. Section of Saharo-Arabian Belt.

If we may now summarize the story of the L. Palaeolithic in the E. Section of the Saharo-Arabian Area, we find that this phase starts with a Pre-Chellean or primitive-Chellean largely represented by trihedral specimens roughly made of pebbles. At one time this was attributed to a so-called "Chalossian" technique, but this is no longer tenable. In Egypt, however, this industry is preceded by a crude pebble facies, which also continued right down to the Chelleo-Acheulean phase [1]. The characteristic tools of this facies are pebbles fashioned by alternating chipping on the two faces—thus giving their cutting edges a zig-zag outline (Pl. VI). The butt is usually left untouched. Only very few flakes were found associated with this culture, whose pebbles, however, may be associated with the Clactonian technique. Unfortunately these pebble-tools have not been discovered in S. W. Asia as yet, and their distribution is very imperfectly known. For the nearest analogies we have to go to E. Africa or to W. Europe (where they are associated with abundant Clactonian flakes). The Chellean proper is well represented in both Egypt and Syria-Palestine. On the Nile (and presumably also on the Euphrates) it is associated with a 30 (and a 27) m. terrace, which may be attributed to the middle part of the 1st Pluvial (*i. e.* roughly Mindel-Riss Interglacial). The Chelleo-Acheulean and Early Acheulean are, on the other hand, little known in either country; though, by inference, they may have corresponded to the latter part of the same Pluvial (*i. e.* roughly advance phase and maximum of Riss). The Middle Acheulean (also not very well known) may have coïncided with the closing stages of this 1st Pluvial (retreat of Riss) and part of the dry Interpluvial (which corresponded to the cool middle part of the Riss-Würm Interglacial). On the other hand, the Up. Acheulean and Acheuleo-Levalloisian (or Acheuleo-Mousterian in Palestine) are well known, and their chronological place may be fixed by relation to the climatic changes. The Up. Acheulean in both countries shows a remarkable degree of resemblance which cannot be entirely explained by a process of parallel evolution. Also

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[1] But also recurring very much later; *vide supra,* remarks in footnotes 2 and 4 on p. 185.

in both countries (or at least in Egypt) it can be placed in the closing stages of the Interpluvial and the advance phase of the 2nd Pluvial (close of Riss-Würm and advance of Würm). During the Acheuleo-Levalloisian, however, both Egypt and Palestine show definite signs of separate evolution. While the former was gradually evolving a local Levalloisian facies of its own, the latter was coming under the influence of a Mousterian, which, in the present state of our knowledge, must be regarded as an introduction imposed upon a local Levalloisian tradition. The chronological correspondence between the two countries continues (early part of the 2nd Pluvial); but we are on the way to cultural (technological) divergence destined ultimately to bear fruit in true Middle (and Up.) Palaeolithic times. But the story must be left here to be resumed at a later stage.

TENTATIVE CORRELATION OF PALAEOLITHIC CULTURES IN W. AND E. SECTIONS OF SAHARO-ARABIAN BELT.

It may be gathered from the conclusions we arrived at as to the L. and early Mid. Palaeolithic in the W. and E. sections of the Saharo-Arabian Belt that there is a fair amount of correspondence between the two sub-areas. As may be expected, the correspondence is not absolute in matters of technological evolution, as local factors must have been of some importance. But in so far as the general outlines of the chronological status of the main culture phases are concerned, it may be stated, with semi-certainty, that there is *broad* agreement between the W. Sahara (with N. W. Africa), N. E. Africa and S. W. Asia (Palestine). This is set forth in Table XIV.

TABLE XIV.

Tentative Chronological Table of the L. (Mid. and Up.) Palaeolithic cultures in the Saharo-Arabian Belt as worked out from sources and references mentioned in footnotes on pp. 164 et seq. (The Table reads upwards and no time-scale is attempted.)

Abbreviations : M., R., W., B. = Alpine glacial phases of Mindel, Riss, Würm (I and II) and Bühl; 1, 2, 3 = their advance, max. and retreat stages (except in case of Würm I and II). Peb. = Pebble artifacts; Ch. = Chellean; Clac. = Clactonian; Ach. = Acheulean; Lev. = Levalloisian; Dim. Lev. = Diminutive Levalloisian; Ms. = Mousterian; S'b. = S'baikian; At. = Atirian and Sab. = Sabylian. (On Atirian, Diminutive Levalloisian and Sabylian *vide infra*.)

PLUVIALS.	W. SAH.-ARAB. AREA (N. W. AFRICA).	E. SAH.-ARAB. AREA. EGYPT.	E. SAH.-ARAB. AREA. PALESTINE.	GLACIAL.
Pluvial II.	Ms. and At. (also S'b.?)	Sab. / Pre-Sab. / Dim. Lev.	Aurigacian. / ?	3, 2, 1 B. / Achen.
	Up. Ach. (and Lev.?)	Ach.-Lev.	Ms.	3, 2 II. W. / 1 I.
		Up. Ach. (and Lev.)	Up. Ach.(?) and Ach.-Ms. (and Lev.?)	
Interpluv.	Mid. (and Up.?) Ach. and Lev.	Mid. Ach. (?)	Mid. (and Up.?) Ach. [and Ach.-Ms.(-Lev.)?]	R.-W.
Pluvial I.	Mid. Ach. and Lev.	(L. and Mid.) Ach.	Pre-Ch. (?), Ch., Ch.-Ach. and L. Ach.	3, 2, 1 R. / M.-R.
	L. Ach. (and Clac.?)	L. Ach.		
	Pre-Ch. (?), Ch. and Ch.-Ach.	Pre-Ch., Ch. and Ch.-Ach. and Peb.		3, 2, 1 M.
	Pre-Ch.? Peb.?	Pre-Ch. and Peb. Peb.	Pre-Ch.? Peb.?	
Pre-Pluv.	?	?	?	Pre-M.

E. (*and S.*) *Africa.*

We must now pass on to a brief consideration of the L. Palaeol. in the Sub-Equatorial and Equatorial zones. Here we have two areas for study; namely E. Africa (with an extension in S. Africa) and India. In spite of earlier finds [1], our detailed stratigraphical knowledge of the L. Palaeol. in E. Africa is due largely to the recent discoveries by L. S. B. Leakey [2]. Thanks to these discoveries we know that at a very early stage (presumably early Pleistocene?) there existed in Tanganyika (and Kenya) a pebble industry which was earlier than (and presumably not mixed with) the Chellean but leading into it [3]. In Leakey's opinion this early industry represents a direct ancestor of the L. Palaeolithic *coup-de-poing* cultures [4]. This is supported by the fact that at Oldoway (Olduvai) there was found in the same section of deposit an unbroken technological succession from the pebble-culture to the advanced Acheulean [5]. It is necessary to note, however, that part, at least, of these pebbles resemble strongly those of 'Abbasyyah (L. Nile Valley) to which reference has already been made (*vide* a little *supra*). They were made by alternate retouching applied, on both faces, on one end of the pebble. In this respect, they also resemble the typical Clactonian pebble implements from W. Europe. To our knowledge, no typical Clactonian flakes (or only very few?) have turned up as yet from E. Africa; and the pebbles must have been prepared for their own

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[1] On such surface finds (from Somaliland) see H. W. Seton-Karr (1896), pp. 271-275 and (1898), pp. 93-95 and J. Evans (1896), pp. 19-21. Also Coll. of Brit. Mus., specimens regist. Somaliland, C. F. 22.5.96; and coll. of Ashmolean Mus. (Oxford) specimens reg. 1928. 259 *a* and *c* and 1928. 260 *b, d* and *i;* also coll. of Mus. of Ethnology and Arch. (Cambridge) spec. reg. 32. 140.

[2] See especially his works (1931), pp. 27-29, 34-39 and Pls. I-IX and Figs. 1-10; also (1933), pp. 668-669; (1933 *a*), pp. 200-201; (1934), p. 73 and (1936).

[3] See L. S. B. Leakey (1936), p. 41; also *vide supra,* footnote 4 on p. 185.

[4] Information also given by Leakey at a special Conference held at Cambridge, March 1933.

[5] See also L. S. B. Leakey (1934), p. 73.

sake (as implements). Indeed, these East African pebble artifacts throw useful light on the question of a possibility of a pebble-culture phase as having preceded (and perhaps also co-existed with) the early *coup-de-poing* industry and its associated flake artifacts. The fact that these crude pebble tools have thus far been discovered only in parts of E. Africa and the Nile Valley (and also N. W. Europe, where they are associated with more numerous Clactonian flakes), may not necessarily mean that their distribution was really limited to these areas.

The Chellean and Acheulean of Kenya resemble in many respects the same cultures in the Saharo-Arabian Area and W. Europe. Certain differences may be attributed to the nature of the material used (usually volcanic) and to slight local developments; but in the main both the technique and its evolutionary process are strikingly the same. Of course, it would not be entirely unreasonable to attribute this to parallel evolution, but, as we shall see later on, some connection must be presumed to have existed between E. Africa and these northern regions. If this be so, a certain measure of chronological correspondence between the major culture-phases of all these regions (or at least E. Africa and the Saharo-Arabian Area) may be expected. Fortunately, the L. (and also Mid. and Up.) Palaeolithic cultures of Kenya can be dated, at least in their relation to local climatic episodes. But as may be noted from Table XV, the difficulty arises when we come to consider the correlations of these episodes with those of Middle and Northern latitudes. If we accept Leakey's correlations, it would mean that the L. Palaeolithic of E. Africa was already approaching its end by the close of the Mindel or the beginning of the Mindel-Riss Interglacial, and that it was followed by the Mousterian and Aurignacian (synchronously) at the beginning of the Riss. Such a system of dating, however, would be difficult to accept, especially as Leakey admits that probably the Middle and certainly the Up. Palaeolithic facies were introduced into E. Africa from the North [1]. It would be unreasonable to assume that the true Aurignacian was already present in E. Africa at the beginning of the Riss, for it did not make its first appearance in W. Europe and Palestine until the passing

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[1] See L. S. B. Leakey (1931), pp. 238-239, also *vide infra* Section II.

TABLE XV.

Chronological Table of the L. and Mid. (with Up.) Palaeol. cultures of E. Africa, together with climatic correlations (1) according to L. S. B. Leakey (1931 and 1934) and (2) to scheme suggested in Table XII, Part I. (The Table reads upwards and no time-scale is attempted.)

Abbreviations : Peb. = Pebble culture; Ch. = Chellean; Ach. = Acheulean, Nanyuk. = Nanyukian (Acheuleo-Mousterian?); Ms. = Mousterian; Aurig. = Aurignacian; Still. = Stillbay; and K. = Kenya; G., M., W., = Alpine glacial episodes.

CULTURES.	K. PLUVIALS.	LEAKEY'S CORRELATION.	SUGGESTED CORRELATION.
K. Late Aurig. and K. Still.	Decline of Gamblian II.	Post-W.	Post-Bühl.
Up. K. Ms. and Up. K. Aurig.	Gamblian II.	W.	Bühl.
?	Relatively Dry.	R.-W.	Achen.
L. K. Ms. and L. K. Aurig.	Gamblian I.	R.	W. I and II.
Nanyuk. (?)	Interpluvial.	M.-R.	R.-W.
Up. K. Ch. and K. Ach.	Late Kamasian.	M.	R.
L. K. Ch.	Mid. Kamasian.	G.-M.	M.-R.
Peb.	Early Kamasian.	G.	M.

of the Würm (I and II) maximum [1]. On the other hand, the scheme of correlation which was introduced at the close of the preceding Part (*vide supra,* Table XII) offers a more reasonable dating.

In S. Africa, the technological succession of culture is more or less similar to that of E. Africa, though there are certain marked differences in the tech-

[1] It may be further added that, as already mentioned (*supra,* Part I, footnote 2, on p. 122), Leakey has also claimed that an Aurignacian facies occurs in E. Africa as early as the close of the Mindel. This could hardly be accepted by any archaeologist, as, not only does it place the introduction of this culture into E. Africa at an unreasonably early date, but it also makes it cover an unreasonably long period.

nique [1]. There are no indications of an early pebble-culture; but the Chellean and Acheulean (except the Uppermost Acheulean) are represented (typologically) by the so-called Stellenbosch, which has a crude technique. An interesting type of implement is the huge so-called Victoria West side-blow flake which is usually worked into a cleaver or a *coup-de-poing,* while the core is also often reutilised as a *coup-de-poing* [2]. The implement is typically S. African, though similar types have come from India [3]. A more advanced facies of the L. Palaeolithic is the so-called Fauresmith, which Breuil equates with the Micoquian of other countries [4]. The advanced Levalloisian and Mousterian are represented by a group of flake industries which are collectively known as the Middle Stone Age cultures. Some of these occur farther North (Kenya), while others seem to be limited to the southern end of the Continent. It may be stated broadly that in spite of similarities with E. Africa and with other more remote regions, the L. and Mid. Palaeolithic facies of S. Africa have a distinctly local character. It is a typical case of a *cul-de-sac* or corner-region, which from time to time must have received impulses from without (either from or through E. Africa), but whose culture was none-the-less able to develop along its own lines [5].

[1] See earlier works of L. Peringuey (1911), A. J. H. Goodwin and C. van Riet-Lowe (1929), M. C. Burkitt (1928), N. Jones (1926); also good summary accounts by H. Breuil (1931), pp. 65-68 and 72 and (1930 *b*), pp. 209-215. See also illuminating attempt at correlation with European and other cultures by C. van Riet-Lowe (1932), pp. 756-764 and (1937), pp. 106-119.

[2] For this type, see H. Breuil (1931), Fig. 20.

[3] See L. A. Cammiade and M. C. Burkitt (1930), p. 332. We have already mentioned (*vide supra,* footnote 1, on p. 179), that A. H. Goodwin draws certain similarities between the Victoria West technique and that of Tachenghit in the W. Sahara. C. van Riet-Lowe finds reason to think that the Victoria West technique also existed in E. Africa, but L. S. B. Leakey does not agree to this; see reference in C. van Riet-Lowe (1937), pp. 111-112.

[4] H. Breuil (1931), p. 65.

[5] As a sign of distinction between S. Africa (whose Stone Age cultures, including both Palaeolithic and Neolithic, follow distinctly local lines of evolution) and the outside world, S. African prehistorians prefer to use a special terminology of their own. They use the following terms : Earlier Stone Age to denote the cultural equivalent of the L. Palaeolithic; Middle Stone Age for the cultural equivalent (more or less) of the middle Palaeolithic and Later Stone Age for the local Upper and Final Palaeolithic and the Neolithic taken together. See C. van Reit-Lowe (1937), p. 109.

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India.

Another region for us to consider in L. latitudes is India (compare our Map. 1 on Pl. I). This peninsula is still relatively little known, and, as we shall presently see, the evidence for the existence of the oldest L. Palaeolithic cultures (Pre-Chellean and L. Chellean) is still inadequate. Even later cultures (Chelleo-Acheulean and Acheulean) are known only from a small number of districts. Yet in spite of the scarcity of the material, some of the finds can be related to definite climatic episodes. Of particular interest, in this respect, are finds made in detrital lateritic material near Madras [1]. We have already seen in our study of S. India (in Part I, pp. 127-129) that during the Quaternary there were two pluvial phases separated by an Interpluvial. The undisturbed laterites of the 1st Pluvial yielded no implements, while the detrital material of the base of the 2nd Pluvial yielded rolled *coups-de-poing,* rostro-carinates, cleavers and Victoria West tools [2]. The strong resemblance between some of these implements (especially the so-called "Madras cleavers") and other L. Palaeol. forms from E. and S. Africa and (to a less extent) the W. Sahara, is fairly clear. Yet if we accept the correlations put forward in Tables XI and XII, the L. Palaeol. of S. E. India (as we know it at present) could not go farther back than the equivalent of the Riss-Würm Interglacial. Indeed a study of the material available leads to the conclusion that we are dealing in India with a fairly advanced facies of the L. Palaeol. (evolved Chellean or Chelleo-Acheulean and Acheulean) [3].

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[1] For early accounts on these finds, see works of R. B. Foote (1866, 1880 and 1916); for recent and more up-to-date accounts, see L. A. Cammiade and M. C. Burkitt (1930), pp. 327-339; F. J. Richards, L. A. Cammiade, M. C. Burkitt (1932), pp. 193-202.

[2] See Cammiade and Burkitt (1930), pp. 329-332, Figs. 1-3 and Pls. I-III. Also on cleavers of Madras type, see R. B. Foote (1916), p. 10, Pl. I.

[3] For such material, see Coll. of the Ashmolean Mus. (Oxford) specimens regist. H. W. Seton-Karr, 1903, Pr. 3, 5; Seton-Karr 1910, 453, 457, 459, 460, 461; also other specimens regist. 1928. 267. Also Brit. Mus. Collect., specimens reg. R. B. Foote, 14. 7. 1868; F. Fawcett, 1909. 12-3. 1-8; H. T. Knox 93. 12-15. 1-12 and J. A. Cockburn 94. 431-464. Also Cairo Museum specimens reg. India, Seton-Karr. So far as could be ascertained, practically all these collections came from S. E. India. L. Palaeolithic implements (including evolved Chellean or Chelleo-Acheulean *coups-de-poing* and clactonian-like flakes) have also been discovered *in situ* by Lieut.-Commander K. R. U. Todd in Salsetti Island, Bombay, and were exhibited at the British Museum, London, in the summer of 1937.

The crudeness of some of the specimens (which recall Early or Pre-Chellean forms) may be largely attributed either to the fact that the material is quartzite or that the particular specimen is an unfinished one [1]. Furthermore no primitive Pre-Chellean types have been found in any numbers that would justify speaking of such a phase. At the same time, the flake industry, which also occurs in the deposits of the 2nd Pluvial, can be definitely related to a much later facies; and in some cases it is accompanied by neatly finished hand-axes [2]. It has no definite relations with either Levalloisian or Mousterian and may represent a local development, on lines more or less similar to those of the Mid. Palaeolithic of S. Africa (Mid. Stone Age). On physiographic evidence it may be approximately related to the equivalent of the Würm (I and II) and Bühl.

THE PROBLEM OF "HOME-LAND" AND "KERNEL-ZONES" OF THE L. PALAEOLITHIC.

General Correlation and Chronology of Cultures.

We have now completed the brief survey of the distribution and the relative (and absolute, so far as could be ascertained) chronology of the L. Palaeolithic over the Old World. This is further given in more concise form in Map 1 (Pl. I) and Table XVI. It is clear that, so far as our present knowledge goes, this culture-stage occurs only in W. and W. C. Europe, parts of the Saharo-Arabian Area, E. and S. Africa and India. Such a distribution could not be without a significance, as it throws useful light on the vexed question of the "centre of dispersal" (or the "home-land" or so-called "birth-place") of Palaeolithic cultures. Such a home-land (if indeed it existed at all in the strict sense

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[1] It may be mentioned in passing that certain authorities (*e. g.* H. C. Das-Gupta, 1923, pp. 10-15) believe in the existence of a Pre-Palaeolithic (*i. e.* Eolithic) in Burma (though not in India proper), which is related to the equivalent of the Pontian Period. Judging from the drawing of the rostro-carinate alleged to have come from the deposits of that period in Burma (*ibid.*, Pl. II), it is difficult to accept the authenticity of this specimen as an artifact.

[2] Cammiade and Burkitt (1930), p. 328.

TABLE XVI.

Tentative (generalized) Chronological Table of L. (Mid. and Up.) Palaeolithic cultures of the Old World. (Compare with Tables XII-XV.) (The Table reads upwards and no time-scale is attempted.)

Abbreviations : Peb. = Pebble (culture or artifacts); Ch. = Chellean; Clac. = Clactonian; Ach. = Acheulean; Mic. = Micoquian; Lev. = Levalloisian; Ms. = Mousterian and M., R., W. and B., = Mindel, Riss, Würm and Bühl glacial phases of the Alps.

GLACIALS.	W. EUROPE.	SAHARO-ARAB. AREA.	E. AFRICA.	INDIA.	PLUVIALS.
B. W.-B. W.	Up. Palaeol. Ms.	Up. Palaeol. Ach.-Lev. (-Ms.) and Ms.	Mid. and Up. Palaeol.	Mid. Palaeol.? Ach.	Pluvial II.
R.-W.	L. Ms. and Mic. Up. Ach. Mid. Ach.? and Lev.	Up. Ach. (Ach.-Ms.?) Mid. Ach.?	Nanyukian?	Ch.-Ach. and L. Ach.	Inter-pluvial.
R. M.-R. M. Pre-M.	Mid. Ach.? L. Ach.? Ch. and Clac. Pre-Ch. ? ?	L. (and Mid.) Ach. Ch.-Ach. Ch. Pre-Ch. and Peb. in Egypt. Peb. (and Pre-Ch.?) ?	Up. Ch. and Ach. Early Ch. and Ch. Peb. ?	Ch.? ? ?	Pluvial I. Pre-Pluvial

of the word) should preferably be looked for in the lands where the L. Palaeolithic cultures occur. In this respect, it would be useful to remember (compare also our Map. 1 on Pl. I) that, while in certain regions the L. Palaeolithic is represented from its very beginning, in others it starts only with advanced Acheulean and later forms. Unfortunately, however, the amount of information available about the successive culture sub-phases of the L. Palaeolithic in different regions is not complete; and any conclusions that may be arrived

at in the present state of our knowledge, must remain subject to future modification or correction [1]. Furthermore, we have seen that, apart from E. Africa, the L. Nile Valley and certain localities in W. Europe, very little is known about the newly recognized stage of pebble-industries, which may have lain (perhaps with other facies) at the base of the L. Palaeolithic. In this respect, it should be remembered that, as we know it at present, the lowest facies of the L. Palaeolithic (the Pre-Chellean or primitive-Chellean) is already a fairly evolved industry, which must have been preceded by a more primitive Pre-Palaeolithic stage. This latter stage may have been partly "Eolithic"; but the strong possibility of a good deal of its artifacts having been made of wood and horn (*i. e.* perishable materials) renders the chance of any illuminating discovery all the more meagre. In these circumstances, it would be vain to try to look for a definite "home-land" or centre of dispersal of human cultures. Indeed we rather prefer to think of a "number" of centres in which Proto-Palaeolithic and Early Palaeolithic cultures may have originated under more or less similar conditions and to meet approximately identical needs, before they got into contact with each other [2]. When, as is hoped, the beginnings of the L. Palaeolithic phase proper become better known, it may be found that these beginnings have resulted from contact and crossing rather than through pure and "specialized" evolution in one locality or another. The old view that the L. Palaeolithic was represented by a pure core or *coup-de-poing* industry has now given way to the more recent one that it was

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[1] The difficulties are further increased by the scarcity of human-palaeontological data from the L. Palaeolithic. A few years ago, L. S. B. Leakey (1933, pp.668-669 and 1933 *a*, pp. 200-201) has claimed the discovery of remains of a certain *Homo kanamensis* and also of true *Homo sapiens* from Kanam and Kanjera, E. Africa. These were, thought to have been, associated with a pebble culture stage and a L. Acheulean industry (or L. and Mid. Pleistocene) respectively. From a more recent investigation of the localities, however, P. G. H. Boswell (1935), p. 371, expresses very strong doubts as to the validity of the geological age of the finds. Nothing could, therefore, be drawn from these exceedingly doubtful discoveries. It is the scarcity of human remains from the L. Palaeolithic which forces us to follow a strictly archaeological line of treatment in the present work.

[2] It should be made clear, however, that this applies only to the beginnings and development of Palaeolithic cultures, and *not* to the rise of the human family which must have originated in a *single* "home-land". Also *vide infra,* next footnote.

formed by a blend, or at least a mixture, of both core and flake tools. It is also illuminating to know that the proportions of the cores and flakes are not always the same in the L. Palaeolithic in different regions. The combination was almost certainly further enriched by wooden and horn implements which have not come down to us. For all this we find it safer, in dealing with the L. Palaeolithic not to speak of "home-lands" but of "kernel-zones", where on the one hand, reciprocal culture-contacts may have been more fruitful, while, on the other, radiating influences and occasional migrations may have made themselves felt in distant lands. It is with this important reservation in mind that we propose now to approach the delicate question of disseminations and diffusions during the L. Palaeolithic [1].

Potential Kernel-Zones of the L. Palaeolithic.

Broadly speaking, there are four main potential kernel-zones for the L. Palaeolithic in the Old World. These are W. Europe, the Saharan (or Saharo-Arabian) Area, E. Africa and India. We shall deal, first with the two outermost ones (W. Europe and India), and follow with the other two.

W. Europe.

W. Europe need not detain us long as a possible source of cultural dissemination. Its very position in a corner on the map of distribution (our Map 1 on Pl. I) reduces its chances as a common centre for inward and outward movements and impulses of human groups and cultures. It may be argued that the frequent oscillations of the climate in this region during the

[1] The present writer has already published an article dealing with problems of "home-land", "cradle", "birth-place" and "kernel-zones" of the L. Palaeolithic. See S. A. Huzayyin (1937-1938), particularly pages 272-280. As already pointed out there (p. 274), we need not draw ourselves into the old controversy of whether the original centre of dispersal of the human family was in C. Asia or on the African Continent. Such a study would be primarily palaeontological, and it would take us far into Tertiary times. It would be much more profitable to limit our treatment to more recent chapters of human history (Palaeolithic, Quaternary) and — in the present state of our knowledge — to deal with the subject from a purely archaeological and cultural point of view.

Pleistocene have given an impetus to the processes of evolution, assimilation and diffusion of the cultures. But this argument can be applied with equal, or even more, force to the Middle latitudes [1]. Furthermore, it is interesting to note that although, so far as we know, the period of the Pre-Chellean and Chellean cultures was on the whole quite genial, these industries did not spread eastwards into C. Europe, while in Italy they were only sparsely represented (compare Map 1). This makes it all the more difficult to think of W. Europe (during early L. Palaeolithic times) as a centre of cultural diffusion into the Saharan Belt, and beyond to E. and S. Africa and India; its assumed expanding groups did not even reach the C. and S. E. parts of their continent. Indeed all indications at present point to the conclusion that although W. Europe must have been an important region of assimilation and increment (and also in spite of possible migrations in the opposite direction), the main drift of culture came from the S. into Europe. As we have already pointed out, the connections with more southerly latitudes must have taken place over the Iberian Peninsula and not over Italy or the Balkans.

India.

The case for India as the "home-land" for the L. Palaeol. *coup-de-poing* cultures has been put forward by Menghin [2]. According to his scheme, Palaeol. industries are divided into "*Faustkeil*" (hand-axe), "*Klingen*" (blade) and "*Knochen*" (bone) cultures—all starting in Asia (India for the first, C. Asia for the second and N. Siberia for the third) and spreading gradually in a west-bound movement [3]. It may be noted, at the very outset, however, that this ingenious scheme could hardly be accepted by most archaeologists of the Palaeol., especially after the recent changes in our conceptions about core and flake industries [4]. The technological sub-division of tools, on lines partly

[1] Such an argument is, on the other hand, less applicable to the Equatorial latitudes, where changes of climate, though somewhat effective, did not have such disastrous effects as in Mid. and N. latitude. Equatorial rainfall at present is supposed to represent interpluvial conditions.

[2] O. Menghin (1931), p. 131.

[3] O. Menghin (1931), pp. 129-132, Karte 1, on page 130.

[4] We now know, for example, that as early as the L. Palaeolithic, core- and flake-tools occur together.

similar to those suggested by Menghin may be applicable to a Pre-Palaeolithic stage, but it certainly could not be applied to the Palaeolithic proper as we know it. Further, the archaeological evidence thus far available from India, hardly warrants speaking of this peninsula as the "home-land" of L. Palaeolithic cultures. As we have already mentioned, the earliest facies represented here may be attributed to an advanced Chellean rather than to a Pre-Chellean industry. Even if we accept Menghin's suggestion as a working hypothesis, the weight of the evidence from the distribution of cultures and from the geological and stratigraphic data from S. E. India would be strongly against it. It is clear from our Map 1 that no L. Palaeolithic finds have thus far been made on the Iranian Plateau. Even if such implements turn up in the future, they are very likely to be rather scarce, as search has already been made for them (in some parts) without success [1]. The absence (up to now), or at least scarcity, of this culture over the Iranian land-bridge between India and the Saharo-Arabian Area would argue for a casual movement (or movements) spreading from the latter region into India rather than for a regular outflow of culture from an Indian "home-land" [2]. Furthermore, we have already seen that on purely geological grounds no Palaeolithic remains from India could be placed, with certainty, at an earlier date than the equivalent of the Riss-Würm Interglacial. This alone may be enough to cast a heavy shadow of doubt on the possibility of an Indian "home-land" for the L. Palaeolithic.

E. Africa.

There remain the two other important kernel-zones of E. Africa and the Saharo-Arabian Area. S. Africa may be excluded, not only on account of its corner-position, but also because its Old Stone Age facies have a distinctly regional character, which disqualifies them as the possible ancestral type of

[1] See J. de Morgan (1896 *a*), pp. 1 ff.; (1899), p. 238; (1902), pp. 708-716; (1909), p. 189. De Morgan attributes the non-existence of such implements to the fact that conditions during the Glacial-Pluvial Period were too severe on the high Iranian Plateau. This may have been so only up to a certain extent, and certainly not continuously.

[2] The spreading of the culture to or from India along a coast-land which may have been different in the Pleistocene remains only a possibility.

the Chellean and Acheulean facies (with their associated flakes) of other regions of the Old World (where the L. Palaeolithic has a good deal in common) [1]. The case for E. Africa has come to light as a result of the recent discoveries of L. S. B. Leakey. It may be recalled (*vide supra,* pp. 196-98) that he discovered (at least at Oldoway or Olduvai) an uninterrupted succession of cultures from the crude pebble forms to the Up. Acheulean [2]. This established for E. Africa a record of Palaeolithic cultures which is hardly surpassed in any other part of the Old World. There are, however, certain important considerations which must be taken into account in weighing the evidence for E. Africa as a centre of diffusion during early Palaeolithic times. In the first place, we have seen that the climatic correlations adopted by L. S. B. Leakey and his associates (and which give the cultures of E. Africa an enormously high antiquity, *vide supra* Table XV) are largely hypothetical and do not fit the facts from elsewhere. On the other hand, the scheme put forward in Table XV (and for which evidence has been adduced in the proper place in Part I) [3] places E. Africa on more or less the same cultural and chronological level as the Saharo-Arabian Area (and W. Europe). The horizon in which the pebble implements occur is roughly attributed (by the discoverer) to the early part of the 1st Pluvial; but this is, in a way, rather conjectural. We do not know whether the Oldoway (Olduvai) beds were not preceded by a phase of local denudation before deposition actually started. There is therefore the possibility that Bed. I (of Oldoway) which contained the pebble artifacts did not mark the very beginning of the 1st Pluvial. Also the fact that E. Africa possesses a continuous and unbroken technological evolution from the Pebble stage to the Up. Acheulean could hardly be cited unreservedly in favour of its being a kernel-zone for the assimilation and diffusion of Palaeolithic cultures. In this respect, it is useful to remember (*vide supra* footnote 1 on p. 205) that, however strong they may have been, the climatic

[1] South Africa, being a *cul-de-sac,* remained out of the way and retained a local character right through Palaeolithic times. It may be further noted that Palaeolithic cultures of S. Africa appear to be later (or even much later) in date than their typological equivalents in other parts of the Old World, including E. Africa (also *vide supra,* Part I, p. 124 and corresponding footnotes).

[2] For the Oldoway (or Olduvai) series of beds and cultures, see L. S. B. Leakey (1934), p. 73.

[3] See also S. A. Huzayyin (1936), pp. 19-22 and Table.

oscillations of the Equatorial Belt could not have had the same disastrous effects as those of Middle and N. latitudes. E. Africa may be therefore looked upon as a region where there was comparatively little need for large scale dispersals or for drastic changes to meet drastically changing (climatic and other) conditions. It is not surprising, therefore, that the cultures of this region should have shown so little variations from the normal course of technological evolution. At the same time, it would be difficult to think of E. Africa as a central area for world-wide dispersals or even infiltrations. Even if this were so, the geographical position of the area would have rendered such diffusions rather difficult. To the West and N. W. of Kenya was a region of (forests and) swamps which must have been still more extensive during pluvial phases. In this direction (Uganda) the L. Palaeol. appears to have been somewhat poorly represented(?). To the N. was the Abyssinian Plateau with its severe conditions (especially during glacial and pluvial episodes). The only suitable outlets from E. Africa were to the N. E. (E. Abyssinia, Somaliland and Arabia) and the South. E. Abyssinia may have provided an adequate outlet; and indeed there is evidence for the existence of an Early Chellean (or perhaps even Pre-Chellean) facies there [1]. It should be recalled, on the other hand, that, to our knowledge, all the specimens known from Somaliland (British) belong to an advanced Chellean or Acheulean facies [2]. Until this fact is disproved by fresh finds (—which is, however, not impossible—), the evidence from this region must weigh against E. Africa as a centre of early diffusion. As to S. W. Arabia, sufficiently careful search has been made for L. Palaeolithic implements within certain areas of Yaman and Hadhramaut, but the country proved to be exceedingly poor in these cultures [3]. This is hardly what would be expected had the centre of diffusion been so close-by in E. Africa. But the most important blow to the E. African case comes from S. Africa. As we have seen, the whole of the Palaeolithic of this latter region

[1] *e. g.* specimen of *coup-de-poing* made of pebble in coll. of Inst. Paléont. hum., Paris, registered as from Vallée de l'Errer, près Ouarka (Harrar).

[2] For collections, *vide supra*, footnote 1 on p. 196.

[3] See S. A. Huzayyin (1936 *a*), pp. 139-140, and (1937 *a*), p. 513; and G. Caton-Thompson (1938), p. 140 and G. Caton-Thompson and E. W. Gardner (1939), p. 30.

has a distinctly local character. The relations which it had with E. Africa must have been in the nature of infiltration rather than of violent diffusions from the North. It is rather peculiar that the technological similarities should be closer as between E. Africa and the Saharo-Arabian Area and W. Europe, than as between the former and S. Africa. This makes it all the more difficult to think of E. Africa as a region whose cultural influences were strongly felt as far as W. Europe, while they were only moderately felt in S. Africa. For all these reasons we prefer to conclude that, unless it developed its own cultures on lines absolutely parallel to those followed in the Mid. and N. Latitudes, (—which would be rather hard to believe—), E. Africa must have received the main technological elements of its L. Palaeolithic cultures from the North (presumably through the E. border of Abyssinia?). If this be so, Kenya and Tanganyika may be regarded as a buffer-zone which absorbed the Northern influences before they could reach the southernmost end of the Land. This provides a more reasonable explanation for the similarities of E. Africa with the North as compared with the more local character of the S. African facies.

Saharan (or Saharo-Arabian) Area.

The final kernal-zone for us to consider is the Saharan (or Saharo-Arabian) Area [1]. Working largely on anthropological grounds, H. J. Fleure has suggested N. Africa as a "cradle" of modern (or *neanthropic*) types of men [2]. His argument, went as far back as the *neanthropic* stage, or the stage during which cultures were associated with ascertained remains of *Homo sapiens*. But the problem with which we are dealing at present takes us to the beginnings of the Palaeolithic stage and it also extends well beyond

[1] This area includes the Sahara, N. Africa (and Egypt) and parts of the N. Arabian East. It does not include S. Arabia, which appears to have been particularly poor in L. Palaeolithic cultures (*vide supra*, preceding footnote).

[2] See H. J. Fleure (1920), pp. 29-32 and (1937) pp. 206-207; also reference in H. J. Fleure (1928), p. 21, and H. Peake and H. J. Fleure (1927 *c*, p. 183).

the limits of N. Africa (*sensu stricto*). The bearing of Fleure's suggestions upon the purely archaeological side of the human story has, in recent years, become more and more manifest. As we have mentioned, however, the archaeological material we have at hand does not allow of speaking of a "cradle" or a "home-land" of Palaeolithic cultures, but rather of "kernel-zones" which served as regions of *contact, increment and diffusion*. In this respect we may note that the Saharan (or Saharo-Arabian) Area enjoys the central position *par excellence* in the distribution of the L. Palaeolithic cultures over the Old World. Its industries start with a Pre-Chellean (or rather Pebble) stage and continue to the Up. Acheulean, when they link up with the Mid. Palaeolithic. From a chronological point of view they are roughly parallel with those of E. Africa and W. Europe. It is true that the Up. Acheulean of such parts as Egypt seems to have persisted well into Mid. Palaeolithic times; but there are good technological reasons to regard this as a progressive continuation of the culture rather than as a stagnant survival. Furthermore, the climatic and bio-geographical (flora and fauna) conditions in this region during Pluvial times were most propitious to the development of early cultures under favourable conditions of assimilation, variation and diffusion. Its open-lands and moderate rainfall attracted migrating (or drifting) groups from the South (forest) and from Europe (during phases of glacial advance?), while, on the other hand, the limitations of its hunting (and collecting) resources must have necessitated either a natural overflow (from time to time) or a violent dispersal (during sub-phases of climatic crises). We have already seen that even during the 1st Pluvial (which corresponded to the main part of the L. Palaeolithic) the total rainfall over the Saharo-Arabian Belt was not very great, and that it was essentially of a stormy character. Variations from year to year were fairly pronounced, and they presumably had some effect upon the movements of human groups. It is also probable that within that major Pluvial there were two short intervals of climatic disturbance and irregularity in rainfall (*i. e.* the transitional phases between the Mindel Glacial and the Mindel-Riss Interglacial and between the latter and the Riss Glacial; *vide* Diag. 6, Pl. V). These temporary oscillations of climate would lead not only to dispersals, but also to adaptations and innovations to meet varying conditions. This is perhaps the reason why the technological sequence of

industries is not so simple in this region as in E. Africa[1]. All these and other considerations of details lead to the conclusion that the Saharan (or Saharo-Arabian) Area is probably the likeliest region to have played the *dual part of assimilation and diffusion*. The areas immediately to the N. and S. of it (*i. e.* W. Europe and E. Africa) were probably in fairly constant touch with it—both contributing to it and receiving from it. On the other hand, more remote regions, such as India and S. Africa, were either relatively late in receiving their first cultural infusions from the main area, or too remote to get under its direct influence.

SUMMARY OF THE STORY OF THE L. PALAEOLITHIC.

If we may now summarize the story of the L. Palaeolithic in the Old World, we find that, as we know it at present, this phase appears from the very beginning as a sufficiently evolved and distinguished culture. It is generally admitted that it must have had some relation to an earlier (Pre-Palaeolithic or Eolithic?) phase, though unfortunately the evidence for this latter is still far from being satisfactory. It is even probable that owing to the decay, beyond recognizability, of the material used for the most part (*e. g.* wood and horn), the Pre-Palaeolithic industries will never be fully identified. Under these circumstances, the inadvisability of looking for a common "home-land" (or number of "home-lands") for the earliest human cultures becomes clear. It has therefore been suggested (in the fore-going paragraphs) that, at least in the case of the L. Palaeolithic, we should look for "kernel-zones" instead of "home-lands". Such "kernel-zones" may have combined the dual function of *assimilating* cultural elements and *diffusing* them. They could be best looked for in the light of the study of the geographical distribution of the industries and their facies, as well as of the climatic and bio-geographical conditions under which these cultures were evolved and diffused. From a glance at our Map 1 (Pl. I), it is clear that the industries of this phase were limited to the area roughly south of a line connecting E. England with

[1] The probable appearance of such facies as the S'baikian may be cited; but better examples of local variations and adaptations will be seen in the Up. Palaeolithic.

N. India. It is interesting that the relatively remote areas (*e. g.* India, C. Europe and parts of Equatorial Africa) did not possess this culture from its beginning, and that even if they did (*e. g.* S. Africa) their facies were largely of a local character and were (in most cases) much retarded in appearance. The only areas which have yielded all the typical sub-stages of the Chellean and Acheulean techniques were E. Africa, the Saharo-Arabian Area and W. Europe. There can be little doubt that each of these areas played its part in the development of the L. Palaeolithic industries. On account of their geographical position, and of certain difficulties referred to in the fore-going discussion, however, the former and the latter of these areas were not the best qualified as "kernel-zones" of the culture. It was rather the Saharan (or Saharo-Arabian) zone which played the main part in the assimilation and diffusion of the L. Palaeolithic industries.

THE MIDDLE PALAEOLITHIC.

PROBLEMS OF ORIGIN AND DIFFUSION.

Flake and Blade Industries of Interior and E. Asia. Their Origin, Chronology and Equations.

Before we bring the present Section to a conclusion, a few paragraphs must be added on the Middle Palaeolithic (to which casual reference has already been made). As may be seen from the comparison of Maps 1 and 2 (Pls. I and II), the distribution of the Mid. Palaeolithic cultures shows marked differences from that of the L. Palaeolithic. The most important facies of the Mid. Palaeolithic (*i. e.* the Mousterian) is predominantly a Eurasiatic industry. Its crudest (and presumably most primitive?) forms occur in the Interior and E. of Asia. The existence of a seemingly Up. Pleistocene flake and blade industry of somewhat undifferentiated character in the Up. Yenisei Basin is of special importance[1]. This includes side-scrapers, points and awls (all comparable with industries from Le Moustier, La Ferrassie and above all La Quina in France) together with narrow blades, core-scrapers and other implements of

[1] On this, see G. von Merhart (1923), pp. 52-55.

typically Up. Palaeolithic appearance. Judging by European typological standards, this industry may be, therefore, regarded as having affinities with both Mousterian and Aurignacian (and perhaps even also Magdalenian—on account of bone implements?)[1]. Some of the relic-bearing horizons lie near the base of a loess deposit, which, in turn, rests on sands and is covered by humus[2]. It is clear that the loess may be attributed to the equivalent of the Bühl or Würm, or more probably both. And if this be so, it would mean that the Yenisei industry corresponded roughly to the same chronological level as the Mid. and Up. Palaeolithic of W. Europe. Of more importance, however, from both technological and stratigraphical points of view, are the more recent finds of N. and N. W. China[3]. The industries thus far available from this region come from two or three fairly distinguishable levels : (1) the Chou-kou-tien (Choukoutien) deposit, (2) the base of the loess, (3) and the loess itself. The first of these (the classical Chou-kou-tien Cave deposit of Locality 1) has yielded an extremely crude quartzite industry (described as "an industry of old palaeolithic type, showing some external Mousterian analogies")[4]. Although some cores seem to have been utilized the industry is characteristically one of flakes. Of special significance is the absence of any definite *biface* forms that might afford a link with the *coup-de-poing* facies of the Western World. And finally we may note that some of the flakes are of the bipolar type (*i. e.* that they have two bulbs of percussion, presumably as a result of having been

[1] The danger of such typological comparisons, however, should not be overlooked ; and conclusions based on them may not necessarily have any definite chronological value.

[2] The associated fauna includes *Elephas primigenius, Rhinoceros tichorhinus, Bos prim., B. priscus, Equus caballus, Canis* sp., etc. See G. von Merhart (1923), p. 21.

[3] On these, see P. Teilhard de Chardin and W. C. Pei (1931), pp. 315-364 ; D. Black (1931), pp. 107-108 and (1934), pp. 89-90 ; and H. Breuil (1931 *b*), pp. 147-154 (1932 *a*), pp. 1-17, (1932 *c*), pp. 1-10 and (1939). Also the two important works by M. Boule, H. Breuil, E. Licent et P. Teilhard de Chardin (1928 *a*) ; and D. Black, P. Teilhard de Chardin, C. C. Young and W. C. Pei (1933). As we shall presently see, these industries are generally much older than those of the Upper Yenisei.

[4] See D. Black and others (1933), pp. 110-141 (quotation from p. 133). See also G. Elliot Smith (1932), pp. 7-10 and illustrations ; P. Teilhard de Chardin and W. C. Pei (1931), pp. 315-364 ; H. Breuil (1931 *b*), pp. 151-153 and (1932 *c*), pp. 4-6 ; and J. G. Andersson (1934), pp. 94-126.

struck by means of crushing them between two blocks). Chou-kou-tien has also yielded a primitive but interesting bone and horn industry, studied recently by H. Breuil [1]. From its deposits have also come the much discussed skeletal remains of *Sinanthropus,* who, according to available data, is regarded as a "generalized", but quite "progressive", early hominid type, which—so far as skull and teeth are concerned—differs essentially from both *Neandertal* and *Pithecanthropus* [2]. The animal and plant associations of the deposit indicate a wetter and rather warmer climate than at present [3]. In particular, the presence of *Bubalus* indicates the prevalence in parts of N. China of marshy and warm conditions, now found a few degrees to the South. We have already suggested (*vide supra* Part I, footnote 1 on p. 40) that this warm wet phase falls best in the equivalent of the Mindel-Riss Interglacial, when not only temperature of the air increased generally over the World, but also sea-temperature appears to have risen. The monsoons probably attained great power of penetration, and they may have also carried more humidity to N. China and the interior of the Continent. If our climatic correlations be accepted, they would help to place the Chou-kou-tien deposit and culture on a chronological level which may not have been far off from the Chellean and Chelleo-Acheulean culture phases of the West.

The second cultural level (the base of the loess in N. W. China) is very scantily represented and may not have been separated by any long interval from that of Chou-kou-tien [4]. Its fluviatile gravels contain a flake industry whose Mousterian-like character is well pronounced, especially as there are no definite blades (*lames*) that might give it a Western Up. Palaeolithic appearance. The faunal remains thus far recovered from the implementiferrous gravel-level are rolled and belong to the Sanmenian (*i. e.* Up. Pliocene or Plio-Pleistocene)

[1] H. Breuil (1939) (with numerous plates).

[2] D. Black and others (1933), pp. 63-109. As to the sense in which the terms "generalized", "specialized", "progressive", etc., are used see *ibid.*, pp. 105-106. It should be also noted that other authorities (*e. g.* E. Dubois and Hrdlička) consider the *Sinanthropus* as a somewhat variant member of the wide-spread *Neandertal* type; see *Nature,* vol. 132, Dec. 16, 1933, p. 925.

[3] See D. Black and others (1933), pp. 50 and 61-62.

[4] See H. Breuil (1928 *a*), pp. 131-134; D. Black and others (1933), p. 137; also P. Teilhard de Chardin et E. Licent (1928 *a*), pp. 23-24.

group [1]. Within the loess proper (third cultural level) are found two sub-levels (or facies) which appear to constitute a more recent phase of the Chinese Palaeolithic [2]. The advent of the loess in N. W. China generally was accompanied by a change in the fauna, which included *Rhinoceros tichorhinus* and became gradually cooler (though at first it was not so) [3]. One group of the loess industries comes from Sjaro-osso-gol, where the facies is characterized chiefly by blades (and also microliths), and according to W. typology would be more of an Aurignacian than of a Mousterian. At Choei-tong-keou, on the other hand, the technique has a more definite Mousterian-like character. It is interesting to note, however, that contrary to what might have been expected (by analogy with the W. typology), the Sjaro-osso-gol horizon is older than that of Choei-tong-keou, both by its fauna and by its stratigraphy [4]. This is of particular importance as it shows that the chronological succession of the flake and blade facies was not necessarily the same in E. Asia as in Europe. The complication is added to by the fact that (as we have already seen) the lowest culture-levels of China (Chou-kou-tien and the base of the loess) appear to have more Mousterian than Aurignacian affinities. We are therefore led to the conclusion that unlike W. Eurasia, N. China and its borders did not have a continuous and homogenous technological evolution, but a combination of two partly contemporaneous culture groups; one predominantly *flake* or Mousterian-like and the other primarily *blade* or Aurignacian-like [5].

As to the date of these cultures, this can only be approximately fixed in the light of stratigraphical and Palaeontological evidence. This brings us face to face with the delicate problem of the age of the Chinese loess. Unfortunately no detailed work has as yet been done on the possible sub-divisions of this

[1] M. Boule et P. Theilard de Chardin (1928 *a*), pp. 95-102.

[2] See H. Breuil (1928 *a*), pp. 103-131; also J. G. Andersson (1934), pp. 146-155.

[3] M. Boule et P. Teilhard de Chardin (1928 *a*), pp. 93-94. On the change, see also J. G. Andersson (1934), pp. 141-142.

[4] H. Breuil (1928 *a*), pp. 130-131.

[5] We should note here the difference between the terms «flake» and «blade». The first is the equivalent of the French *éclat* and indicates relatively broad (and more or less triangular) specimens, while the second is the equivalent of the French *lame* and indicates narrow and elongated (and usually less massive) ones.

loess, so that we do not know whether it belonged to one or more phases of æolian activity. Judging by analogies with loess formations outside Asia, and also by the change in the fauna that took place with the advent of the loess, it seems justifiable to equate this latter with the second half of the Glacial Age (*i. e.* with Riss and Würm taken together)[1]. Some authorities, however, (notably D. Black) prefer to be less definite and to regard it as "broadly Würm"[2]. This latter view implies that the gravels (and culture) underlying the loess were Riss-Würm. Yet we find that D. Black and his associates correlate the Chou-kou-tien deposits (and culture) with the closing stages of the Mindel. This leaves too long an interval between the Chou-kou-tien and the Loess (including the equivalents of M.-R. Interglacial, R. Glacial and R.-W. Interglacial) which is not warranted by the physiographic, palaeontological or cultural evidence. We find, therefore, that until fresh evidence is brought to light, it remains difficult to accept the correlations put forward by D. Black. From the evidence thus far available, it seems more reasonable to place the Chou-kou-tien deposit and its culture (and presumably also the implementiferrous base-gravel of the loess) in the equivalent of the Mindel-Riss Interglacial (perhaps its closing stages?) and the loess proper (with its industries) in that of Riss and Würm taken together.

As to the origin of this culture (or cultures), the matter seems to be sufficiently clear in spite of the relative scarcity of data. The absence of any authentic Palaeolithic finds S. of the Tsin-ling Mts.[3] excludes (at least for the present) the possibility of the industry having come from the South. In fact, there are strong indications that we are dealing here with a largely autochthonous C. (or E.-C.) Asiatic culture. The fact that in C. and E. Europe there are (as we shall presently see; *vide* also next Section) indisputable evidences of a *westward* spread of the flake (and blade) industries of the Mid. (and also Up.)

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[1] We have already seen in the preceding Part that the Ice Age of Northern Asia may be divided into two main phases separated by a long and genial Interglacial, which can be equated with the Mindel-Riss Interglacial of the Alps (*vide supra,* Table IV; also footnote 1, on p. 40). Reference to the correlation of the Chinese loess with Riss and Würm together is also made in V. K. Ting (1931), p. 11.

[2] D. Black and others (1933), pp. 59-61.

[3] See D. Black and others (1933), p. 139.

Palaeolithic makes it highly improbable that the exceedingly primitive facies of C. and E. Asia were originally introduced from Europe. So far as our present knowledge goes, therefore, it seems feasible to conclude that during an early stage in their recent geological history, the Steppe-lands of C. and N. Asia had a common culture sub-stratum (or *nappe*) of their own, which was essentially characterized by a flake (and blade) technique enriched (*e. g.* at Chou-kou-tien) by bone and horn artifacts. Judging by Western standards, this industry was largely atypical and un-specialized. Its distribution and chronological status are not sufficiently known as yet, but it would be safe to assume that as a culture area, it stood in contrast to, and entirely apart from, the Eurafrasian zone (if we may use that term to include W. Europe, Africa, S. W. Asia and India) of the Chelleo-Acheulean (core and flake) technique. For some reason or other, however, the Asiatic flake group began to spread westwards and south-westwards into the other zone during both the Mid. and Up. Palaeolithic phases (as we know them in the West)[1]. As may be expected, vast technological changes took place as a result of this movement of expansion, and it remains for us to point out very briefly the main trends of this movement during its early stage (*i. e.* Mousterian) and its effects especially along the zones of contact between the two cultures.

The Spreading of the Mousterian towards W. Europe.

The spreading of the Asiatic flake culture in the Mid. Palaeolithic seems to have followed two main trends : one towards W. Europe and the other in the direction of Palestine[2]. In E. and C. Europe there are abundant traces of crude industries difficult to classify, but which may be reasonably grouped

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[1] It may be noted as a possibility that whereas during the warm Interglacial of Mindel-Riss the Eurasiatic Steppe received an abundant supply of rainfall, it probably suffered from relative drought during the cool (or relatively cold) middle part of the Riss-Würm Interglacial. This may perhaps account for the large movement of expansion, or dispersal, which took place during the latter phase.

[2] The flake finds that may be classified as Mid. Palaeolithic in India are so scarce and atypical (see L. A. Cammiade and M. C. Burkitt, 1930, pp. 328, 338-339) that they do not justify our speaking of an appreciable spread from C. Asia into that Peninsula. Can they represent an autochthonous development?

under the general name of Pre-Mousterian [1]. It is difficult to say whether this facies of E. Europe corresponded partly to the Chellean-Acheulean facies of the West; but at any rate it is safe to assume that it lay at the base of the typical Mousterian culture of the Mid. Palaeolithic. This latter culture (or a facies of it) seems to have made its first appearance in the extreme western parts of the Continent some time during the latter part of the last Interglacial (R.-W.); though it was not definitely established there until the beginning of the last Glacial [2]. That it represented a racial invasion there, may perhaps be indirectly inferred from the fact that in various places it was found associated with remains of *Homo Neandertalensis* which also occur further East [3]. The earlier Mousterian facies was rather of a mixed nature, as it was best represented by a combination of advanced Acheulean (Micoquian) forms and Levalloisian and Mousterian flakes [4]. It is not really until we come to the so-called "cave" phase of the Mousterian (with its cold fauna) that we find the industry in its typical and more or less pure form [5]. From W. Europe the industry was introduced into the Côte d'Azur [6] and more particularly spread in the direction

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[1] This term was first given by H. Obermaier (1924), pp. 87-90.

[2] The physiographic and palaeontological evidence from N. France and adjacent parts of N. W. Europe is definitely in support of this dating (compare also our Table XIII). Some of the workers in S. France (*e. g.* E. Passemard, 1921, pp. 758-760) arrive at similar conclusions, while others (*e. g.* D. Peyrony, 1930, pp. 47-49) incline to place the first appearance of the Mousterian there as early as the close of the Riss. The evidence in support of this latter view is rather difficult to accept.

[3] The association of Mousterian culture with possible dispersals of *Neandertal* man (and related types) from the Asiatic Steppe is now steadily gaining ground. In this respect we may mention in passing the recent reports of the discovery of remains of *Homo Neandertalensis* (in a sterile layer, but seemingly underlying a level with Mousterian-like industry?) at the foot of Hissar Mts., Bukharah (W. Turkistan). See H. V. Vallois (1939-1940), p. 626; also note in *Nature,* Jan. 3rd 1940.

[4] On the difference between Levalloisian and Mousterian techniques (as referred to in the present work), *vide infra,* footnote 2 on p. 221.

[5] Even then, however, certain old forms still survive.

[6] On this see M. Boule (1927, p. 103). In the case of Italy it is difficult to say with absolute certainty whether the Mousterian was introduced from the N. W. or from the N. E. (direction of Krapina), though the latter alternative may be more probable. On Mousterian of Italy see R. Vaufrey (1928), pp. 37-84.

of Iberia [1]. In this latter area it extended over various parts of the Plateau, and was also found at the Rock of Gibraltar (where it was associated with a *Neandertal*-type skull) [2]. From there the Mousterian appears to have crossed into N. Africa where it made itself felt in many parts of Little Africa and the Sahara [3]. In the former region its remains are found *in situ* both in the interior (cave and drift deposits) and on the coast (in formations capping the 17 m. Monastirian beach). In the Sahara proper, on the other hand, it is so-far known only from surface finds. Judging from the physiographic, faunistic and climatic data, to which reference has already been made (*vide supra* Part I, Tables VII and IX), it is fairly safe to attribute this culture to the 2nd Pluvial (equivalent of the last Glacial), without being too exact about which part of it. But it is interesting to note that although the Mousterian technique was able to assert itself in this part of Africa, it soon under-went profound changes, especially towards the close of the Mid. Palaeolithic. From it was finally evolved the industry of Bir al-Atir, characterized by tanged points, tanged end-scrapers, blade-knives and notched and other scrapers which largely took the place of the typical Mousterian *racloir* of Europe [4]. Unfortunately, in spite of the fact that this industry was actually found *in situ* at the type-station, it was not possible to define its chronological place among the Mid. (and Up.) Palaeolithic cultures of N. Africa [5]. For this we have to depend, either on

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[1] On the Palaeolithic of the Iberian Peninsula in general see H. Obermaier (1928), pp. 336-348.

[2] See D. A. E. Garrod (1928), pp. 48-54, Figs. 6-10. For a summary account on the skull see L. H. Dudly-Buxton (1928), pp. 83-85.

[3] For general accounts of its distribution and its various sites see H. Breuil (1931), pp. 69-70; also H. Obermaier (1930), pp. 260-261. (Compare also our Map 2, Pl. II).

[4] M. Reygasse, who first discovered this industry *in situ* has given it the name of Atirian (*Atérien*); see his works (1922), pp. 167-193 and (1921), pp. 533-556 (especially pp. 554-556).

[5] It may be noted that other authorities who found this industry only on the surface have tended to consider it (and in some cases still do) as Neolithic or "néolithique à tradition moustérienne". See J. de Morgan, Capitan et V. Boudy (1910), p. 274; E. Gobert (1914), pp. 32-42 (where he speaks of the "néol. à trad. moust.") and P. Pallary (1909), pp. 51-52 (where he speaks of it as the "néol. berbère", *i. e.* very recent or local protohistoric) and (1922), p. 373 (where he denies Reygasse's conclusions about the Atirian). The Palaeolithic date of the Atirian has now been established not only in N. Africa but also in other regions such as Egypt. For further precisions *vide infra*.

local typological considerations or on recently ascertained stratigraphical data from outside N. W. Africa (Egypt and Palestine *vide infra* Section II). From these it appears that the Atirian belonged to the latter part (or decline) of the 2nd Pluvial, and that almost certainly it continued well into Up. Palaeolithic times. This is further supported by the discovery of various surface stations in the Sahara and N. Africa, which have yielded new tool-types (not represented at the type-station) such as laurel-leaves (very abundant) burins (very rare) and blades and blade-points of a definite Up. Palaeolithic appearance[1]. But this point will be taken up in more detail in the following Section.

Palestine in the Middle Palaeolithic.

The second line of spread of the flake-cultures of the Asiatic (or Eurasiatic) Steppe was in the direction of Syria and Palestine. Mousterian implements have been found *in situ* in caves in Kurdistan and in Palestine, and on the surface in many places on the plains to the N. of Arabia[2]. In the whole of this region (excluding Kurdistan?), the early Mousterian facies became mixed with the Uppermost Acheulean as testified by the existence of fine *coups-de-poing* (though not always of a Micoque type) and also of Levallois flakes. The most acceptable assumption would be that prior to the advent of the Mousterian, the region was already occupied by a typically advanced Acheulean and Acheuleo-Levalloisian culture (making both *coups-de-poing* and flakes)[3]. It is also almost certain that the Mousterian industry was brought in by a racial type (*Palaeanthropus Palestinus*), which was closely related to that of *Neandertal*[4]. This, together with the very close technological resemblances, make it highly probable that the Mousterian of Palestine was introduced from the

[1] See H. Breuil (1931), p. 70.

[2] For Kurdistan see D. A. E. Garrod (1930), pp. 25-42. On Palestinian cave remains see F. Turville-Petre (1927), pp. 21-22, Plates X-XIV; D. A. E. Garrod (1933), pp. 1010-1011 and (1934 *a*), pp. 85-89 and (1934 *b*), pp. 142, 144; also Garrod and Bate (1937).

[3] On the Up. Acheulean and Acheuleo-Mousterian (and associated facies such as the Tayacian) see D. A. E. Garrod (1934 *b*), pp. 146-150 (especially also p. 144 where the Levalloisian element is mentioned). See also R. Neuville (1931), pp. 22-51. On Levalloisian and Mousterian techniques, also *vide infra* footnote 2 on p. 221.

[4] See A. Keith (1927), pp. 53-106; T. D. McCown (1932), pp. 12-15, and D. A. E. Garrod (1933), pp. 1010-1011.

same place of origin as that of W. Europe. But the typical Mousterian was presumably not the only Asiatic (or Eurasiatic) facies to find its way into Palestine. In the Acheuleo-Mousterian level of the Tabun Cave was discovered a group of implements including Châtelperron points, end-scrapers, gravers and a whole series of narrow blades with nibbling retouch on the edges—all belonging to a distinctly Up. Palaeolithic facies[1]. D. Garrod considers this group as being due to contact with a very early Aurignacian, rather than a development on the spot from the Acheuleo-Mousterian industries. If this be so, it would mean that about the same time as the expansion of the Mousterian-like (flake-point) facies from the N. Steppe of Eurasia, there was also a spreading of an Aurignacian-like (blade) facies. We shall presently see that this assumption may perhaps also be supported by evidence from E. African material. It is all in agreement with the remarks we have just made about the two flake-facies (Mousterian-like and Aurignacian-like) of the N. Steppe.

On the evidence of fauna and climate the advent of the Mousterian in Palestine (*i. e.* Acheuleo-Mousterian) may be dated to the transition between the Interpluvial (Riss-Würm) and the 2nd Pluvial (Würm), while the Mousterian proper probably coïncided with the early part of the same Pluvial (*vide supra* Part I, pp. 100-101, also present Section Table XIV). In this respect, it corresponded roughly to W. Europe.

Egypt in the Middle Palaeolithic.

The Mousterian technique *sensu stricto* appears to be very little represented (if at all) in Egypt[2]. In spite of similarities between the Up. Acheulean facies of

[1] D. A. E. Garrod (1934 *b*), pp. 147-148.

[2] It may be necessary to refer to the difference between Levalloisian and Mousterian techniques (in the sense used in present work; see also H. Breuil 1937 *a*, Table). The former is characterized by flakes with predominantly prepared striking platforms, but with very little lateral retouch (apart from occasional steep trimming). Mousterian flakes, on the other hand, have a smaller proportion of prepared platforms, but exhibit the typical *sloping lateral retouch* of the well known Mousterian type. It is not known as yet, however, whether the two industries had entirely separate origins (*i. e.* whether the Levalloisian descended from some early flake industry in the Eurafrican domain and the Mousterian from some crude Pre-Mousterian industry on the Asiatic Steppe), or whether they both represented divergent branches from one

Egypt and Palestine (*vide supra*), the two countries seem to have followed different lines in the Mid. Palaeolithic. As contrasted with the sequence in Palestine, the Up. Acheulean and Levalloisian facies of the L. Nile Valley were able to continue almost unaffected by outside influences. Among the various finds from Egypt, hardly any (or only very rare) flakes exhibit the typical surface retouch of the Mousterian proper [1]. Also the tortoise cores of the Egyptian Mid. Palaeolithic are of a distinctly local type. Of special interest is the so-called "tortoise point" made of a triangular Levallois core, with retouch (entirely preparation-flaking?) on its convex face and especially on its tip (which is rendered stronger by a typical oblique blunting or retouching from the convex face; our Pl. IX, 2 and explanatory note) [2]. This distinctly "Egyptian" character of the Mid. Palaeol. of N. E. Africa continues, practically unaffected, right through that phase (and also the Up. Palaeolithic). Towards its end, the Levalloisian technique evolves into a new local facies which can

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and the same (Asiatic) stem. If we accept the first alternative, we may assume the existence of some Pre-Levalloisian facies in various parts of the Eurafrican domain (perhaps derived from the Clactonian or such other facies as the Victoria West and similar techniques; see *e. g.* C. van Riet Lowe, 1937, pp. 110 and 113). It is possible, however, that the Levalloisian may have represented an early Asiatic migration, which became associated with the Acheulean in W. Europe and Saharan Africa and perhaps also in Palestine at some earlier moment than the arrival of the Mousterian wave with its more developed technique. This latter possibility may be supported by evidence from Khargah Oasis (Egypt), where the Levalloisian seems to have been *imposed* upon the Upper Acheulean—thus forming the Acheuleo-Levalloisian. Before that, Levalloisian affinities were characteristically scarce in the Up. Acheulean of the Oasis which appears at first to have been pratically unmixed with Levalloisian (verbal information kindly given by G. Caton-Thompson; see also her report (1932), pp. 132-133; also *vide supra,* pp. 190-191). For some reason or other, however, only the Levalloisian (but *not* the Mousterian) facies could get into Egypt. But in the present state of our knowledge, the whole problem of whether the Levalloisian and Mousterian had separate or united origin must be left an open matter.

[1] See *e. g.* drawings in K. S. Sandford and W. J. Arkell (1929 *d*), Figs. 12-19 (only Fig. 12 exhibits any secondary retouching at all; and even in this case the technique seems to be in the Acheuleo-Levalloisian tradition), and (1933), Plates XXX-XXXIX. Compare also our Pl. X and explanatory notes. H. Breuil (1931, p. 71) was the first to introduce the term Levalloisian instead of Mousterian in dealing with Egypt.

[2] On this type of artifact see C. G. Seligman (1921), pp. 123-128, Figs. 2 and 3. So far as is known, this type does not occur outside Egypt—except perhaps very sporadically in Palestine.

best be termed "Diminutive Levallois" [1]. This latter leads into the so-called Pre-Salylian and the Salylian (Up. Palaeol.) in Up. Egypt, while it persists and continues to form the late-Mid. and Up. Palaeol. of N. Egypt. But we propose to leave the story of the Egyptian flake (and blade) industries at this stage, to be taken up in the following Section.

S. W. Arabia and E. (and S.) Africa in the Middle Palaeolithic.

The fact that Egypt was very little affected—if at all—by the Mousterian, raises the point of whether that culture became confined to Palestine or was spread from there in other directions, such as the interior of Arabia or E. Africa. In this respect, it may be noted that the Middle Palaeolithic thus far known from S. W. Arabia is represented by a crude and relatively unprogressive facies of the Levalloisian [2]. It does not show any clear signs of contact with the outside world, and certainly not with the Mousterian. It cannot be attributed to local development from the Lower Palaeolithic, as its flakes were not associated with any *coups-de-poing,* while the L. Palaeolithic itself was particularly poor in that region. This Levalloisian of S. W. Arabia can therefore best be taken to indicate an archaïc drift of flake culture, which reached this corner of the Arabian Peninsula and persisted in it [3]. On the opposite coast of Africa, however, an industry with Mousterian-like affinities is known from Somaliland and Kenya [4]. It is difficult, in the present state

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[1] On this newly recognised facies see Huzayyin (1939), p. 208, Pl. I; also *infra,* Sect. III.

[2] See more particularly G. Caton-Thompson and E. W. Gardner (1939), p. 30; also S. A. Huzayyin (1936 *a*), p. 139 and (1937-1938), p. 281, footnote 1.

[3] Perhaps was this assumed drift parallel to that which may have brought the Levalloisian into N. E. Africa (passing through Palestine at an earlier date than the Mousterian wave proper)? *Vide supra,* footnote 2 on p. 221. In Egypt, this Levalloisian seems to have been *imposed* upon (and enriched by) a surviving but progressive Up. Acheulean, and so it continued its evolution and development in the relatively rich environment of the L. Nile Valley. It led ultimately to the Diminutive Levallois and the Up. Palaeolithic. In S. W. Arabia, on the other hand, the crude industry remained stagnant and largely unprogressive.

[4] For surface finds from Somaliland see coll. of Brit. Mus., specimens reg. Somali. C. F. 22.5.96 (707, 719 and 678); also coll. of Mus. of Archaeol. and Ethn. (Cambridge), reg. 1932. 2-8 (A. T. Curle Gift) and Achmolean Mus. (Oxford), reg. Seton-Karr 1895. 128. On Kenya see work of L. S. B. Leakey (1931), pp. 78-83, Figs. 11-12.

of our knowledge to explain the existence of this facies here, but L.S.B. Leakey has suggested the possibility of the so-called Kenya Mousterian having been evolved on the spot from the local Up. Acheulean[1]. Indeed it is possible that a flake industry (coarse Levallois) may have passed through S. W. Arabia into E. Africa, where it found a highly progressive *coup-de-poing* industry, with which it got into contact. This contact may have been responsible for the development of the so-called Mousterian-like technique which was hardly represented by more than ordinary (and thick) Levallois flakes, on some of which further flaking (partly *à l'Acheuléenne?*) has been applied. The same process may have ultimately led to the development of such facies as the Stillbay in E. and S. Africa[2]. The possibility of a crude flake (Levallois) industry having reached E. Africa from Arabia may be further strengthened by the fact that a group of Aurignacian-like blades has been discovered in deposits containing the Up. Kenya Acheulean[3]. We believe that we have here (in Kenya) a case very similar to that of Palestine (*vide supra*, p. 221)—namely that at some stage during the later Acheulean a culture-facies containing both flake and blade (Aurignacian-like) elements was introduced from the North[4]. Whatever this may have been, it is clear that the story of Middle Palaeolithic cultures in E. Africa still needs clarification. In the present state of our knowledge nothing can be said with certainty as to the origin and contacts of the industries of that part of the Africain Continent.

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[1] On this interesting possibility see L. S. B. Leakey (1931), pp. 234-235.

[2] It is suggested by certain authorities (*e. g.* M. C. Burkitt, 1928, pp. 87 and 170, also reference in Leakey, 1931, p. 80) that the Stillbay may have resulted from contact between the Mousterian and some other culture of a Neanthropic type. The Stillbay is found also in S. Africa. It is interesting to add that specimens approximating to this facies have more recently been found in an Acheuleo-Mousterian level in Palestine (see D. Garrod, 1934 *b*, p. 146). This latter similarity, however, appears to be rather superficial.

[3] Reference to this is made in E. Nilsson (1931), pp. 343-344 et D. A. E. Garrod (1934 *b*), p. 148.

[4] In this respect, it is useful to remember that the so-called Kenya Mousterian (or Levallois?) and Kenya Aurignacian run concurrently. See L.S.B. Leakey (1931) pp. 30-31. It is assumed that the two cultures corresponded to two ethnic, and perhaps also racial, groups; as otherwise it would be difficult to account for their having occupied the land for so long (the whole of the 2nd Pluvial, *i. e.* equivalent of Würm and Bühl) without having mixed with each other. [Compare also with early occurrence of blades in W. Europe; *infra*, p. 228].

From E. Africa certain Mid. Palaeolithic influences infiltrated into S. Africa, though, as in the L. Palaeolithic, this region retained its local stamp[1]. In spite of similarities with E. Africa (*e. g.* in the case of the Stillbay technique), the so-called "Middle Stone Age" cultures of S. Africa (especially its early facies represented in the Mossel Bay and the little known industries preceding it)[2] appear to have been (at least partly) evolved locally. It can be said with a fair measure of certainty that they lingered rather later than the Mid. Palaeolithic of Kenya[3].

SUMMARY OF MIDDLE PALAEOLITHIC CULTURE SPREADS AND CONTACTS[4].

And now to sum up the story of the spreading of the Middle Palaeolithic flake culture of the Mousterian (and Levalloisian?), we find that it probably had its main (or its common?) centre somewhere on the Eurasiatic Steppe. Its expansion was along two main trends : into C. and W. Europe and N. W. Africa on the one hand, and Palestine (and other parts of Arabia as far as E. Africa?) on the other. It is not known at what time it began its movement into C. Europe, but it is practically certain that it did not reach the western margin of that Continent until the closing stages of the Riss-Würm Interglacial. At first it became rather mixed with the Uppermost Acheulean, but later on it developed into a more specialized culture (the Mousterian proper). Italy received an intrusion of this culture either from the N. E. or from the N. W., but the industry did not penetrate as far as Sicily or Calabria. Spain, on the other hand, was over-run by the advancing Mousterian civilization which also reached N. Africa. This southward movement probably coïncided with the advance of the Würm Glacial, though the chronological place of the Mousterian in N. W. Africa (and the Sahara) is not quite clear as yet. It seems also that, having reached this latter region, the W. branch of the Mousterian was already at the end of its journey, and it

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[1] For general accounts of the Mid. Stone Age cultures of S. Africa see H. Breuil (1930), p. 215 and (1931), p. 72; and C. van Riet Lowe (1937), pp. 106-109 and 113-114.

[2] On these see C. van Riet Lowe (1937), pp. 113-114.

[3] See C. van Riet Lowe (1937), Table III and p. 115.

[4] Compare also our Map 2 on Pl. II and accompanying explanatory note.

soon developed into the local facies of the Atirian. This latter spread widely over the Sahara and reached Libya, Egypt and Palestine. As we shall see in the following Section, however, its date in the latter two countries may be stratigraphically fixed within the Up. Palaeolithic.

The E. branch of the Mousterian spread into Palestine. This movement also probably started during the equivalent of the latter part of the Riss-Würm Interglacial. As in the case of W. Europe, the Mousterian here was associated with a *Neandertal*-like man[1]. But in spite of its proximity to Egypt, the Mousterian culture did not (or could hardly) make itself felt in the latter country. Here, we have a region which maintained its highly developed Acheuleo-Levalloisian and Levalloisian and was able to evolve a distinct Mid. (and Up.) Palaeolithic technique of its own. In this respect, N. E. Africa stands almost unparalleled in the Old World. It is not known whether the Levalloisian of the L. Nile Valley (and Khargah etc.) was introduced thither from the Asiatic side (*via* Palestine) or from N. Africa and the Sahara. On the other hand, it appears that an expanding early Mid. Palaeolithic facies took its course over Palestine and Arabia to E. Africa. It was able to establish itself in this latter country; but it was apparently nearing its journey's end. The extreme S. corner of the Continent was able to maintain its own facies along largely independent lines (especially Mossel Bay technique).

It is not known whether the Mousterian facies reached India at all.

CONCLUSIONS RELATING TO THE L. AND MID. STAGES OF THE PALAEOLITHIC.

The main conclusions arrived at in the foregoing survey of the L. and Mid. Palaeolithic may be roughly enumerated as follows :

(1) As we know them at present the cultures of the L. Palaeolithic are of a sufficiently evolved technique to make it necessary to suppose the existence of an earlier (Pre-Palaeolithic) stage. Unfortunately, however, the evidence for this stage remains exceedingly fragmentary.

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[1] But see also more recent interpretations of the mixture of racial characteristics of the Mousterian people of Palestine in T. D. McCown and A. Keith (1939) ; also review and criticism of same by W. E. Le Gros Clark in *Man,* April 1940, p. 59.

(2) This makes it out of the question, when studying the L. Palaeolithic, to look for a definite "home-land" from which the cultures expanded. We find it safer to think only of "kernel-zones", where various cultural elements may have got into contact with each other, and from which radiating influences may have reached both neighbouring and distant lands. This applies more particularly to the Eurafrasian Area (covering W. Europe, most of Africa, S. W. Asia and India) which was characterized by a *coup-de-poing* and flake culture. On the other hand, the Eurasiatic zone (N. Steppe of Eurasia), whose implements were all flakes (and also bones and horn) seems to have had a more definite centre of dispersal. It is possible that this culture originated somewhere on the N. Steppe-land Belt (perhaps more probably in its E. C. or E. part?) about the same time as the *coup-de-poing* (and flake) culture was in its Chellean stage.

(3) The Eurafrasian Area had three main kernel-zones; W. Europe, the Saharan or Saharo-Arabian zone and E. Africa. Of these the second one was the most important, not only on account of its geographical position, but also because of the climatic and bio-geographical conditions that prevailed over it in the early part of the Diluvium. E. Africa and W. Europe, however, seem both to have played their respective parts in the technological evolution of the culture. On the other hand, India and S. Africa represented remote corner areas. The former received the culture at a comparatively late stage, while the latter was able to develop its facies along largely independent lines.

(4) The Steppe-land Area seems to have had two facies from the very beginning; a true *flake* industry and a *blade* one. The former (or a group of it) became later on associated with the Mousterian, which spread from a common centre (presumably in E. Europe?) in two main directions. One branch spread over W. Europe and reached N. Africa and the Sahara (where it became partly responsible for the Atirian), while another made its way into Palestine. It is interesting, however, that the expanding Mousterian did not exert any appreciable influence upon N. E. Africa which maintained a highly specialized Acheuleo-Levalloisian and Levalloisian technique of its own. The

origin of this Levalloisian of N. E. Africa still remains undecided[1]. But it is not impossible that an early Levallois sub-facies may have passed through Palestine in the direction of Egypt (where it became at first progressive, and then diminutive) on the one hand (?), and S. W. Arabia and E. Africa on the other. In this latter region (E. Africa) it seems to have got into contact with local cultures and to have gradually led to the development of a fairly advanced technique in the late Middle Palaeolithic. S. Africa, however, was presumably only indirectly affected by the infiltration from the North; and so it maintained a good deal of its local characteristics. As for India, it may have hardly been affected by the expanding flake technique of the N. Steppe—at least it did not yield any Mousterian artifacts. The other *blade* facies of the N. Steppe was presumably connected with what became later on known as the Aurignacian. It appears, however, that even at an earlier date than the Mousterian some of the blade groups were able to spread in the direction of Palestine and E. Africa on the one hand, and W. Europe on the other[2]. Nevertheless, the main movement of the spreading of the

[1] Indeed this is the case with the Levalloisian facies in general. In spite of the light which has been thrown recently on the origin and beginnings of the Mid. Palaeolithic in general, the problem of the Levalloisian still presents certain ambiguities. It is now certain that the L. Palaeolithic group of the Chellean-Acheulean in Eurafrasia included among its artifacts certain flake facies. It is not known, however, whether these could have been responsible for the development of some of the facies of the Mid. Palaeolithic. It may be possible to conjecture that some of these old Eurafrasian (or Eurafrican) flake techniques may have helped in the evolution of the Levalloisian, but the possibility of this latter culture having been at least partly introduced from the Asiatic Steppe cannot be excluded. Perhaps when the so-called Levalloisian industries known (and still to be known) from various regions in Europe, Africa and S. W. Asia are more carefully studied, it will be found that this facies of the Mid. Palaeolithic had a complex origin, and that more than one drift (according to regions) have combined in its evolution (?).

[2] *Vide supra,* pp. 221 and 224; also *infra,* p. 234. H. Breuil (1937, p. 14) thinks that as early as his Levallois III-IV and VI-VII in N. France there are indications of an infusion of a blade technique (though relatively massive) into W. Europe (perhaps coming from the East?). In the neighbourhood of Le Moustier blades have been discovered in a level underlying a Mousterian or Mousterian-like industry (reference in *ibid.*). All this shows the complexities of techniques and also of cultural drifts in the Mid. Palaeolithic.

blade industries did not come until a later phase—the Up. Palaeolithic—with which we shall deal in the following Section. But it is interesting to note that, whereas we know that the Mousterian was nearly everywhere (*i. e.* wherever human remains were found with it) associated with *Homo Neandertalensis* or a closely related human type, the Aurignacian proper was associated (in Europe, Palestine and E. Africa) with *Homo sapiens*. Are we to assume that the two facies of the N. Steppe corresponded to two ethnic and racial groups? Was the true flake facies (or the Mousterian-like sub-facies of it) associated first with *Sinanthropus* and later with a *Neandertal* type, while the blade facies (Aurignacian-like) belonged to a *H. sapiens* or a close relative? Or would it be more reasonable to think of the Aurignacian as having evolved (perhaps in E. Europe?) quite independently from the early blade industry of N. W. China? And in that case would this latter sub-facies be attributed to a relative of *Sinanthropus* of the Chou-kou-tien (Choukoutien) region? All these are questions which cannot be answered with any certainty in the present state of our knowledge. Any attempt to answer them would be sheer speculation, from which it is safer to refrain. But the archaeological side of the problem will be further elucidated in the following Section.

PART II (*Continued*).

SECTION II.

THE UPPER (AND FINAL) STAGES OF THE PALAEOLITHIC : A STUDY OF THE ORIGINS AND DISTRIBUTIONS OF CULTURES IN THE OLD WORLD : WITH SPECIAL REFERENCE TO THE SAHARO-ARABIAN AREA AND EGYPT.

INTRODUCTORY :

The Middle and the Upper Stages of the Palaeolithic.

The present Section is intended as a continuation and a completion of the preceding one. The vast movements of cultural contact (between the African and Asiatic zones), which started with the Mid. Palaeolithic phase continued right through Up. Palaeolithic times. We have already seen (*supra,* p. 215) that in spite of the rather undefined character of the industries discovered in the loess of N. W. China, the Sjaro-osso-gol finds had an Aurignacian-like (and also microlithic) appearance[1]. The blade-technique is more pronounced here than in other sites of N. W. China (*e. g.* Choei-tong-keou) where the flake industry has a more Mousterian facies. We have also seen (*supra,* pp. 212-213) that (apart from miscellaneous surface finds especially from the borders of Gobi[2]), a crude Up. Palaeolithic-like industry also occurs in loessic formations in the Upper Yenisei[3]. All these industries are in a way rather atypical and non-specialized (in the Western sense). Whether they represent a generalized form of a blade industry that went on concurrently with the Mousterian-like flake industry of the same region (but did not spread westwards, to any appreciable extent, until a later stage), is a matter

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[1] See H. Breuil (1928 *a*), pp. 122-131.
[2] See D. Black and others (1933), p. 139.
[3] See G. von Merhart (1923), pp. 52-55 ; also reference in Menghin (1931), pp. 198-199.

that must remain subject to conjecture so long as our knowledge of the region remains very imperfect. Perhaps the most practical approach to the question will be a rapid survey of the distribution and characteristics of the Up. Palaeolithic cultures, followed by an examination of whatever possibilities there might seem likely to be for a spreading of these cultures either from Asia or from somewhere else.

THE AURIGNACIAN : ITS ORIGIN, EVOLUTION AND SPREADING.

The Aurignacian in W. Europe.

E. and C. Europe have in recent years enriched our knowledge about the Up. Palaeolithic [1]. An Aurignacian facies is found at numerous places in the loess area. A group within the general province of this industry is now termed for preference (especially in Moravia) as "primitive Aurignacian" [2]. Its technique seems to have been rather affected by a pseudo-Mousterian facies of the region, though it does not exhibit the typical Mousterian flaking. Whether this unspecialized industry may be in the direct ancestry of the classical Aurignacian of W. Europe remains a matter of opinion. It is generally admitted, however, that the Aurignacian of the West is not an autochthonous culture there [3], and that, in all probability, it was introduced from the East during the phase of cold-steppe which followed immediately on the passing of the first maximum of the last glaciation (*i. e.* Würm I and II taken together) [4]. It is interesting that, although the fauna of the Aurignacian (and

[1] For recent accounts, see V. J. Fewkes (1929), pp. 20-26 ; H. Breuil (1923 *a*), pp. 323-336 and (1924), pp. 271-291 ; H. Obermaier (1925 *a*), pp. 55-58 and L. Kozlowski (1924), pp. 112-160 ; also various works by K. Absolon (1927) and (1927 *a*), and K. Absolon and R. Czizek (1927 *b*) ; and E. Hillebrand (1919).

[2] See reference to K. Absolon (1927 and 1927 *a*) in V. J. Fewkes (1929), p. 21, and O. Menghin (1931), p. 139.

[3] On this point see H. Breuil (1912), pp. 172-174 and (1937), pp. 11-15.

[4] The eastern origin is now generally accepted for the Mid. Aurignacian. As to the L. Aurignacian it is thought by certain authorities that it started somewhere in N. Africa, whence it spread to W. Europe *via* Spain. See vague (and rather hesitant) reference in H. Obermaier (1924), pp. 201-202, and more definite reference in M. C. Burkitt (1933), pp. 146-148 (where the L. Aurignacian is supposed to have started somewhere in the S. Sahara). Discussion of this view will be taken up a little later.

also the Solutrean) included reindeer and other members of the Arctic-Alpine fauna, these types occur less frequently than in earlier (Up. Mousterian) times or in the later (Magdalenian) phase ; which indicates that the Aurignacian and Solutrean probably occupied the Achen oscillation between Würm (I and II) and Bühl [1]. The technological and stratigraphical succession of the Aurignacian has been carefully worked out in many type-stations especially in France ; and the following summary may be given [2] (most recent at top) :

5. Font Robert Stage : with Font Robert points (narrow and tanged).
4. Up. Aurignacian : Gravette knife blades (narrow, straight blunt back).
3. Mid. Aurignacian : Beaked graver, high core scraper (*grattoir caréné*) (or hoof-shaped scraper). Also split-base bone lance points (*pointe d'Aurignac*).
2. L. Aurignacian : Châtelperron knife blade (curved blunt back).
1. Audi Stage : Audi knife-blade (rather triangular).

These typological sub-divisions are important, as unfortunately we shall have to fall back on them for comparative purposes, whenever it is not possible to obtain any more reliable chronological data. Although such classifications may be applicable, in all their details, only to W. Europe, the fact that they have been established on ascertained stratigraphical data, and that the Aurignacian was a foreign introduction into W. Europe, may perhaps render it fairly safe to use them for purposes of comparisons with regions outside Europe [3].

The typical Aurignacian, however, is not represented all over W. Europe (compare our Map 3 on Pl. III). We may note, for example, that an Up. Palaeolithic facies, which extends into Italy and the Côte d'Azur, has a strongly specialised and regional character which justifies its being called "Grimaldian" [4]. This industry has certain affinities with Krems and Willendorf in

[1] See H. Obermaier (1924), p. 98. F. Wiegers (1928), p. 178, appears, however, to place the beginning of the Aurignacian a little earlier.

[2] See the classic works of H. Breuil (1912), pp. 175-188 and (1937), pp. 17-29 ; also summary account in M. C. Burkitt (1933), pp. 140-142.

[3] Such typological, however, comparisons may not necessarily have an absolute chronological value.

[4] This term (first proposed by Rellini) has been adopted by R. Vaufrey in his work on Italian Palaeolithic (1928), pp. 85-115. See also O. Menghin (1931), pp. 167-169. On the *Côte d'Azur,* see M. Boule (1927), pp. 91-113 (where the industry is just regarded as Aurignacian).

L. Austria [1], though in point of time (or at least as a culture-phase), it seems to have corresponded to the Aurignacian, Solutrean, and Magdalenian of W. Europe put together. On the other hand, the Aurignacian is more typically represented in the Iberian Peninsula, though only in the North. The S. and C. parts of the Peninsula have an Up. Palaeolithic technique associated with the Capsian of N. W. Africa [2]. As we shall infer later on, however, it is most probable that the whole of Spain received its Upper Palaeolithic from the North. This recalls what happened during the Middle Palaeolithic, when Mousterian flake industries entered Spain from the same direction [3]. But we shall return to this delicate question when we come to consider the origin and dispersal of the blade cultures of W. Europe and other regions.

The Solutrean and Magdalenian in W. Europe.

The Aurignacian was followed in W. Europe by the Solutrean and Magdalenian. Both these cultures are European in distribution, and would, therefore, throw little light on the question of World-distributions of the Up. Palaeolithic with which we are at present dealing. It is now generally agreed that the Solutrean started somewhere in E. Europe (probably on the Hungarian Plain?), where it was represented by a Proto-Solutrean facies [4], while the Magdalenian may have had something to do with the early bone industries of N. C. Siberia [5], though it is also argued that it started in the

[1] This was first pointed out by H. Breuil (1912), see p. 184; see also D. Garrod (1930), p. 22.

[2] Except for the E. coast of Spain (which was invaded by the Solutrean), the same division of the Iberian Peninsula into two unequal culture-zones continued also during Solutrean and Magdalenian times. Compare maps Figs. 87 and 89 in H. Obermaier (1924).

[3] Certain blades, including relatively fine blunt-backed specimens, scrapers and other semi-typical Upper Palaeolithic implements, discovered *in situ* near Madrid, were at first thought to belong to a Mousterian level; see H. Obermaier (1924), p. 201. This, however, has been discredited; see H. Breuil (1937), p. 34.

[4] See V. J. Fewkes (1929), pp. 22-23. See also H. Breuil (1937), pp. 33-34, where allusion is also made to the possibility of a complex origin (or origins) of the Solutrean.

[5] On this, see H. Breuil (1937), pp. 43-44.

region of the French Pyrenees [1]. At any rate, these two industries (or at least the Solutrean) represented fresh invasions into W. Europe, and it is interesting that the latter of them (Magdalenian) was also in turn ousted by the Epi-Palaeolithic culture (Tardenoisian). It is probable that this latter reached N. W. Europe from somewhere in the South [2].

The Aurignacian in S. W. Asia (and E. Africa ?).

The Aurignacian technique appears also to have made itself felt in S. W. Asia [3]. We have already seen (*vide supra,* p. 221) that as early as the Acheuleo-Mousterian of the Tabun Cave in Palestine, a blade facies of undoubted Up. Palaeolithic appearance was represented [4]. This, however, was an isolated occurence; and it is not until after the Up. Mousterian proper that we get to the true Aurignacian levels [5]. The lowermost Aurignacian facies of this region is scantily represented but includes massive gravers and end scrapers together with leaf-shaped points of an Atirian technique [6]. This latter feature, however, provides the only link with N. Africa (W. Sahara) during the whole of the Upper Palaeolithic. The Middle Aurignacian is very richly represented, and it includes well-made scrapers (especially the hoof-shaped specimens), gravers of all kinds and blades and points worked all round with typical retouch of the Mid. Aurignacian of W. Europe. It is interesting, however, that bone implements are characteristically lacking; and

[1] See Obermaier (1924), p. 120. Also reference in M. C. Burkitt (1933, p. 154) to the possible development of the Magdalenian from the Aurignacian, perhaps influenced by the Solutrean.

[2] See H. Breuil (1912), pp. 223-224; and (1937), pp. 73-74.

[3] So far as India is concerned, only a relatively small number of blade implements, which in Europe would be classified as Aurignacian, have thus far been discovered. We seem to be here "on the periphery of the Up. Palaeolithic culture"; see L. A. Cammiade and M. C. Burkitt (1930), pp. 328 and 338-339.

[4] See D. A. E. Garrod (1934 *b*), pp. 147-148.

[5] On the Aurignacian of Palestine, see good summary of recent excavations by D. A. E. Garrod (1934 *b*), pp. 138-142. See also more comprehensive work by Garrod and Bate (1937).

[6] These leaf-shaped points are usually unifacial (*i. e.* worked only on the edges and from a single face, the upper one), but have careful retouch at the base of the bulbar face. D. Garrod (1934 *b*), p. 142, suggests calling them (and similar pieces from W. Sahara) "Tabelbalat points". They also occur in the Atirian of Khargah Oasis (*vide infra*). (Our Pl. XIII, No. 1.)

this cannot be without significance as in Europe the "split-base" bone point or *pointe d'Aurignac* is especially typical of this stage. The Up. Aurignacian is also well represented in Palestine, though it is not quite comparable with that of W. Europe. In fact the Mid. and Up. Aurignacian of Palestine appear to show closer affinities with a newly discovered sub-facies in Crimea and S. Russia [1]. The Palestinian Up. Aurignacian also appears to have persisted perhaps down to the Final Palaeolithic phase. Nevertheless, it included rather large lunates or Châtelperron knives, which were at first taken to indicate Capsian affinities. This latter view, however, has now been discarded [2]; and it appears that none of the Aurignacian facies of Palestine was connected with the Capsian of N. W. Africa.

The approximate chronological place of the Aurignacian of Palestine is not difficult to determine. The evidence of fauna indicates a change (with an oscillation) from a wooded to a more open country (*vide supra,* pp. 99-102); and this helps to place the culture at the latter part and the close of the 2nd Pluvial. If the correlations put forward in Part I (*vide supra* Table IX; also Table XIV) be accepted, it would seem that the Aurignacian of Palestine corresponded to the equivalent of Bühl [including both its advance (with Achen?) and retreat phases] [3].

Another interesting Up. Aurignacian industry of S. W. Asia is that of the Caves of Kurdistan [4]. It contains Gravette points but seems to be fairly distinct from the Up. Aurignacian of W. Europe. At first it was thought to bear resemblances to the Grimaldian of Italy and to Krems and Willendorf industries of Austria, but now it has been shown to be more related to the newly discovered industry of Transcaucasia [5].

The Aurignacian industry is thought by E. Vignard to have passed from Palestine into Egypt [6]. In an open-air station at Nagʿ Hammadi he found an industry which he identified as Aurignacian, largely on the evidence that it

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[1] See D. Garrod (1936 *a*), pp. 164-165.
[2] See D. Garrod (1934 *b*), p. 138, where she discards a view which she expressed earlier.
[3] The latter part and decline of that Pluvial started after the equivalent of Würm (I and II).
[4] See D. Garrod (1930), pp. 15-22.
[5] See D. Garrod (1936 *a*), p. 164.
[6] Ed. Vignard (1920), pp. 5-15 and (1929), pp. 299-306.

included burins of various types. Other implements were scrapers, knife-blades, and what is more interesting, axes whose cutting edges were re-sharpened by knocking off transversal flakes (*éclats d'avivage*) [1]. It should be noted, however, that the existence of the burin can no longer be taken as an unfailing evidence of an Aurignacian (or even an Up. Palaeolithic) facies or date. As we have seen (*vide supra* Part II, Sec. 1, footnote 3 on p. 190) this type of implement has been found as early as the Up. Acheulean or Acheuleo-Mousterian of Palestine; and we shall further see (in Section III), that it was again present as late as the Eneolithic (Chaleolithic) of both that country and Egypt (where it is found even in historic times). Furthermore, the Sabylian (*i. e.* the typical Up. Palaeolithic of S. Egypt) was characteristically lacking in burins, which appear only in its later phase—and then only as micro-burins (*vide* a little *infra*). It is evident, therefore, that the main argument on which Vignard bases his dating of the Nagʿ Hammadi station is no longer tenable. It is also interesting that the re-sharpened axes (and their *éclats d'avivage*) were discovered *in situ,* in kitchen midden remains datable by pottery as late as the Pre-Dynastic phase of Egypt (*vide infra* Section III). This puts an end to the assumption that these axes were Aurignacian [2]. The Nagʿ Hammadi station is nothing but a Pre-Dynastic settlement, whose lithic industry (collected on the surface) was mis-interpreted by Vignard [3]. As to the true Up. Palaeolithic of Egypt, it had its own facies, which differentiated it from the Aurignacian of both Palestine and W. Europe. It will be studied separately at a later stage.

In Kenya Colony a so-called Aurignacian (or Aurignacian-like) facies has been discovered by Leakey [4]. Its lower stage is scantily represented and consists almost entirely of crude backed blades. The Up. Kenya Aurignacian is,

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[1] For illustrations of these "*haches*" and their *éclats,* see Ed. Vignard (1929), Pl. V, Nos. 2 and 3. (Also for a re-sharpened axe see our Pl. XV, No. 8; and S. A. Huzayyin (1937), pp. 207-211 and Pl. LVII, LXII and LXIII.)
[2] In fact such re-sharpened axes have already been found in Pre-Dynastic settlements as early as end of last century; see J. de Morgan (1897), Fig. 165 on p. 83.
[3] On this point, see also S. A. Huzayyin (1937), pp. 198-199 and (1939), pp. 243-244.
[4] See L. S. B. Leakey (1931), pp. 90-109 and Figs. 15-35. The industry has been termed by Leakey as the "Kenya Aurignacian". This was necessary to distinguish it from the true Aurignacian of W. Europe or Palestine, from which it is largely different.

on the other hand, more characteristic. It consists of ordinary backed blades, (Châtelperron type), backed lunates (some of which being rather microlithic), scrapers of various types (usually on blades, and not including the high core or hoof-shaped type), burins of various descriptions (including the micro-burin type), so-called sinew-frayers, as well as pottery, some bone awls, etc. If we were to draw any comparisons between this industry and that of Europe, both the L. and the Up. Kenya Aurignacian (taken together) would show certain typological resemblances to the Châtelperron (*i. e.* Lower) Aurignacian group. At the same time, however, there are no noticeable similarities between the industries of E. Africa and those of Palestine (where the facies is on the whole of a Middle Aurignacian type). Kenya lacks two of the characteristic types of the true Mid. Aurignacian; namely the high core- (hoof-shaped) scraper (with fluted retouch) and the blade-points with flat or sloping retouching on both margins. On the other hand, it enjoys an over-abundance of ordinary blades and burins[1]. So far as the dating is concerned, we have to rely entirely on the physiographic data, as the evidence of the fauna is of little help[2]. According to the physiographic interpretation of Leakey the L. Kenya Aurignacian is attributed (rather vaguely) to his first sub-maximum of the 2nd Pluvial (*i. e.* Gamblian I) together with the following relatively dry interval and perhaps also the advance phase of his second sub-maximum (Gamblian II). The Up. Kenya Aurignacian is attributed, with more certainty, to the phase of decline of his second sub-maximum. If our correlations, and not those of Leakey (reflecting C. E. P. Brook's opinion), be accepted (*supra,* Tables X, XI, XII and XV), the so-called L. Kenya Aurignacian may be equated with Würm I and II, Achen and the advance of Bühl, while the so-called Up. Kenya Aurignacian would be placed in the equivalent of the retreat of Bühl (and later stadia).

We have already mentioned (end of Section 1) that the Kenya Up. Palaeolithic facies are supposed to have been contemporaneous with the *so-called* Kenya

[1] The material from Kenya is almost entirely obsidian. It is not known in what measure did the glassy nature of this rock affect the technique.

[2] On the fauna of the Up. Gamblian deposits, see A. T. Hopwood (1931), pp. 273-275. The L. Aurignacian has yielded no identifiable animal remains. It is interesting to note, however, that the fauna of the Up. Gamblian is all recent, and that, with the exception of one or two specimens, it still exists. This may perhaps betray the comparatively recent age of the deposits.

Mousterian (of Levallois origin ?), though the two industries did not mix with each other. In some cases, however, especially in the later stages of these cultures, there are slight evidences of such a mixture (or rather contact) having taken place between facies derived respectively from the so-called Upper Mousterian and Up. Aurignacian (of the region). The mixture is not so well marked in Kenya as outside it, especially in Somaliland and S. E. Abyssinia. According to H. Breuil, Mousterio-Solutreo- (*i. e.* Stillbay-like) Aurignacian implements occur together in definite levels in some of the caves of this region[1]. With them are also microliths of a Final Palaeolithic character. This latter feature is interesting as it shows that, as in the case of Kenya, the dividing-line between the Mid. and Up. Palaeolithic, on the one hand, and the Final Palaeolithic on the other, was not a sharp one.

S. Africa need not detain us long[2]. As is the case in the Mid. Palaeolithic, the Up. Palaeolithic of this corner-region had a fairly pronounced regional character (compare our Map 3 on Pl. III). In certain parts the Stillbay facies (of late Mid. Palaeolithic derivation) is predominant, while in others a blade culture with more Up. Palaeolithic affinites (the Smithfield) makes its appearance. The most characteristic implements of this latter culture are the end-scrapers, the small thumb-scrapers, the small side-blow flakes, and a number of burins. It may not be improbable that this culture was partly contemporaneous with the so-called Up. Aurignacian of Kenya, but it is also certain that it survived for some time after the latter. In its Upper stage it became mixed with the microlithic industry of the Wilton; and there are also indications that it was indirectly affected by the Pre-Dynastic civilizations of Egypt[3].

Summary of Aurignacian Drifts.

We have now completed the brief survey of the distribution and chronological status of the Aurignacian and Aurignacian-like cultures of the Old

[1] On the Caverne Porc-Epic (at Dire-Daoua), see H. Breuil (1934), pp. 473-474.

[2] For relatively up-to-date accounts, see H. Breuil (1931), pp. 80-82 and C. van Riet Lowe (1937), pp. 95-98 and 114.

[3] *e. g.* stone-bracelets, palettes,... etc., of fairly definite Egyptian appearance; see H. Breuil (1931), pp. 82 and 94; also (1937 *b*) pp. 158-159.

World. It has been seen that these industries were probably connected—somehow or other—with a primitive blade technique somewhere on the N. Steppe of Eurasia. As Early as Mousterian times blade-using groups were spreading (though sporadically) both into W. Europe and in the direction of Palestine and E. Africa. In the present state of our knowledge, however, the *direct* ancestry of the Aurignacian can be traced only to E. and E. C. Europe and not to the interior of Asia proper. In the former region was discovered a so-called primitive-Aurignacian which is now accepted by most authorities as a *possible* proto-type of the Aurignacian of W. Europe. This latter region received its culture (from the East) at least in two successive waves; the first leading to the appearance of the L. Aurignacian and the second to that of its Middle facies (*vide infra* for further discussion). The Up. Aurignacian may have simply represented a reversion to an advanced form of the L. facies, after the decline of Mid. Aurignacian influences. In N. W. Europe the three sub-facies of the Aurignacian may be dated roughly between the Würm and Bühl.

Certain parts of Europe, however, exhibit special features. The Italian Peninsula has a special facies of a so-called Grimaldian, which was largely developed on the spot, though it also had some connections with an evolved facies of the Aurignacian in Austria. The story of the Iberian Peninsula is still more interesting, but it will be studied with Africa a little later.

Another branch of the Aurignacian is that of Palestine. Here the facies shows close connections with Transcaucasia, Crimea and S. Russia, and it belongs more to the Mid. than to the L. Aurignacian. Indeed this latter is very poorly represented in S. W. Asia as a whole. An advanced form of the Aurignacian seems to have been evolved locally from the Mid. Aurignacian especially in Palestine. But it seems that, on the whole, the S. Russian Steppe and S. W. Asia were fairly well in relation with each other during the whole of the Middle Aurignacian (and also its advanced phase).

Judging by faunal evidence, the Aurignacian of Palestine may be roughly equated with the Bühl [and its advance (with Achen?) and retreat phases]. It is probable, therefore, that it was somewhat later—or at least survived longer—than the Aurignacian of W. Europe (compare also Table XVII below).

The remaining region that is said to have been reached by the Aurignacian was E. Africa. Here the facies belonged to an early form and had no connection

either with the industries of Palestine or with the Mid. Aurignacian of W. Europe. Its nearest analogies are with the L. Aurignacian of this latter region [1]. The L. Kenya Aurignacian is only scantily represented and it may have been, at least partly, evolved locally from an early blade-group which was introduced (from the North) as early as the close of Acheulean times. It is not also known in what measure was the so-called K. Aurignacian (especially its Up. facies) due to fresh introduction from the North. Such an introduction could not have taken place *via* the L. Nile Valley (which yielded no Aurignacian and also no related industries such as the Capsian, *vide infra*); and even if it came *via* Palestine, it should have passed through it at an early stage, and before the establishment of the Mid. Aurignacian facies in Palestine. But the origin and the exact technological contacts of the Up. Palaeolithic of E. Africa must remain, for the present, open matters.

THE UPPER PALAEOLITHIC OF LITTLE AFRICA AND W. SAHARA.

The Atirian. Its Derivation and Distribution.

It remains for us to survey the Northern part of the African Continent [2]. Here, we have two major culture-zones : Little Africa and the W. Sahara, on the one hand, and N. E. Africa, on the other. Beginning with the first we find that the Mid. Palaeolithic cultures seem to have persisted in this region. We have already seen in the preceding Section that the Atirian (Atirian) facies was probably evolved from an advanced (perhaps retarded) Mousterian. Unfortunately it is not possible to judge from the type station of Bir al-'Atir (Constantine) the exact chronological place of the Atirian [3]. Judging typologically,

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[1] It also bears similarities with the Capsian ; but this may perhaps be due to the fact that this latter culture was connected (in its origin) with the L. Aurignacian of W. Europe (*vide infra*).

[2] We need only make a passing reference to the Tumba culture of the Congo Basin, and its extension into W. Africa. In the Congo it is chiefly characterized by exceedingly massive and thick elongated flakes, usually worked only on one face and having a plano-convex section. See works of Menghin (who first identified the culture) (1925), pp. 516-557 and (1926), pp. 833-850. This author considers the Congo facies as representing a local Up. Palaeolithic, but Vanfrey, who studied its extension in French Guinea finds good reason to consider it (at least there) as very much later in date (Post-Neolithic). See Delcroix and Vaufrey (1939 *b*) pp. 311-312. (Also Breuil, 1931, pp. 94-95).

[3] On the Atirian, see M. Reygasse (1922), pp. 167-193 ; also (1921), pp. 533-556.

however, it seems to have occupied a position intermediate between the true Mousterian and the Up. Palaeolithic. According to Reygasse, some typically Mousterian forms occur, but on the whole the scrapers seem to predominate over the crude *"racloirs"*, while blade-nuclei of Up. Palaeolithic fracture are also found [1]. In other parts of the W. Sahara and also in W. Morocco, a form of Atirian is associated with industries of decidedly late Up. and Final Palaeolithic age [2]. In the region of Tabelbalat, the Atirian facies is characterized by leaf-shaped points of a type which elsewhere (in Palestine and Egypt) occurs in definite Up. Palaeolithic levels [3]. The industry also contains tanged points which show on their upper surface clear traces of blade flaking—thus betraying their association with an Up. Palaeolithic blade technique (*vide* illustrations on our Pl. XIII, No. 2; also pieces similar to No. 9) [4]. In N. W. Morocco (and presumably also along the Tell region) the tanged point persisted well into the lower levels of the Oranian (or Ibero-Maurusian) which, as we shall presently see, was either contemporaneous with, or a little later than, the typical Capsian [5]. Indeed, there is good reason to think that both prior to the appearance of the Capsian and concurrently with its early part, there flourished in various parts of the W. Sahara (with intrusions into Little Africa proper) an Up. Palaeolithic industry which was largely based on the Atirian (compare Map 3 on Pl. III). Whether this industry penetrated into Spain or not is a matter of conjecture, though certain discoveries seem to point to the existence of some early Atirian traces in that country [6]. On the other

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[1] See M. Reygasse (1921), p. 554.

[2] See H. Breuil (1931), pp. 69-70; also E. Gobert and R. Vaufrey (1932 *a*), pp. 467-486.

[3] *Vide supra*, footnote 6, on p. 235, also *vide* a little *infra*. For illustrations, see our Pl. XIII, Nos. 1 and 8, also 5. For specimens, see Coll. of the Institut de Paléont. hum. (Paris), regist. Tabelbala 1915-1919-22 and Boubout-Iguidi 1915-22. See also H. Breuil (1931), pp. 70-71 and Figs. 29-30 and 32. These leaf-points are found in many places in the W. and S. W. Sahara.

[4] A. Debruge [(1922 *a*), Fig. 1 and (1925), Fig. 2] has also found tanged blades (showing persistance of Atirian technique) in what are seemingly early Capsian *escargotières* in N. W. Africa.

[5] See E. G. Gobert and R. Vaufrey (1932 *a*), Fig. 14, No. 13 and Fig. 18, Nos. 2 and 3.

[6] See reference to so-called Atirian implements discovered in supposed Mousterian (or Up. Palaeolithic) beds near Madrid, in H. Obermaier (1930), pp. 258-259 and 273. These implements, however, include no tanged points (the type-specimen of the Atirian).

hand, it is almost certain that the main direction of the spreading of the evolved (Up. Palaeol.) Atirian was towards the East. In Cyrenaica this facies has been found though only from the surface [1]. In Egypt it was recorded as early as 1880 [2] and a number of surface finds have followed since [3]. It was particularly recognized by C. G. Seligman, who attributed it to the so-called Mousterian [4]. More recently, however, Atirian implements (including both tanged points and leaf-shaped points of the Tabelbalat type) have been discovered by G. Caton-Thompson *in situ*, in some of the fossil spring deposits and Wadi formations of the Khargah Oasis [5]. On the stratigraphical evidence of this region, the Atirian followed on the so-called Pre-Sabylian (end of Mid. Palaeolithic or rather beginning of Up. Palaeolithic) and may be dated to the early decline phase of the last sub-maximum of the 2nd Pluvial (*i. e.* early decline of Bühl). There can be little doubt that the implements in question represented an intrusion from the West during the Up. Palaeolithic of Egypt. This is also supported by the evidence from Palestine where the Tabelbalat leaf-points, however, seem to occur at an earlier date than in Khargah, *i. e.* in the lowest level of the Aurignacian (*compare supra* footnote 6 on p. 235; and also p. 236).

The Capsian (and Other Cultures). Complexities and Survivals.

But the Atirian and its derivative forms do not represent the whole of the Up. Palaeolithic facies of N. W. Africa. There are of course the Capsian and the somewhat different culture of the Oranian (formerly known as Ibero-Maurusian) [6]. Certain authorities prefer to consider the L. Capsian (charac-

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[1] See R. Battaglia (1930), pp. 9-11 and Figs. 5-6.

[2] See F. Mook (1880), Taf. XI, Nr. 6.

[3] Interesting specimens come from the Siwah Oasis. See Coll. of the Museum of Arch. and Ethn. (Cambridge), specimens regist. 24.1109 and 24.1114. See also our Pl. XIII, Nos. 5-7.

[4] C. G. Seligman (1921), pp. 128-129 and 142 and Figs. 4 and 31-35.

[5] See G. Caton-Thompson (1931 *a*), p. 82 and Fig. 4; and (1932), pp. 130-131; also Caton-Thompson and Gardner (1932 *a*), pp. 384 and 404. Also see our Pl. XIII, Nos. 8-9.

[6] The term "Capsian" suggested by J. de Morgan and others (1910), pp. 217-286 and 335-347, is universally accepted in preference to the "Getulian" of P. Pallary (1909), pp. 44-45. We shall therefore use the former not only in dealing with this particular industry, but also in

terized by a massive blade technique) as Aurignacian [1], though this can hardly be justified on technological grounds. That there are certain similarities between the Capsian and the L. (and also Up.) Aurignacian of W. Europe cannot be denied, but the typical (Mid.) Aurignacian implements of the latter region (*e. g.* high hoof-shaped scrapers and points with flat marginal retouch on upper surface) are practically lacking in N. W. Africa. The Capsian is made up largely of blades (of Châtelperron and Gravette types), blade scrapers and an abundance of angle-burins (with straight or concave upper edge). The retouch is usually bold and steep, though the absence of keeled and core scrapers and of other exceptionally thick implements had led to the relative scarcity of fluting retouch. Nearly all authorities have hitherto divided the Capsian into two levels : a lower one with large implements and showing more affinities with the industries of W. Europe, and an upper (typical) one in which microliths and geometrical forms predominate [2]. More recently, however, R. Vaufrey has claimed that the microliths occur from the very beginning of the Capsian and that the reason for their not having been recorded before is that they were not properly looked for [3]. The new researches by Vaufrey have thrown immense light on the technological composition of the Capsian; though unfortunately the number (or rather the extent) of settlements (*escargotières*) he excavated could hardly be regarded as large enough, definitely to bear out all his conclusions. For the moment, at least, the possibility that his excavations (especially in cases where means at his disposal allowed only of trial trenches) have been concerned mostly with sites or parts of sites that

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the case of the so-called *Intercapsonéolithique,* which was formerly called (by E. Gobert, 1914, pp. 19-22) as *Intergetulonéolithique*. Also on this point of N. African terminology, see E. G. Gobert and R. Vaufrey (1932 *a*), p. 487.

[1] *e. g.* E. Koken (1909), pp. 8 and 15; M. Reygasse (1921), pp. 560-570 and (1922), pp. 194-204, and A. Debruge (1925), pp. 61-70. This latter author, however, contradicts himself, as although he calls the industry as Aurignacian he asserts that it did not contain any "burins". This can only be explained by the fact that such implements (difficult to identify) were overlooked by him. [On similar criticism, see also E. G. Gobert and R. Vaufrey (1932 *a*), pp. 457-458.]

[2] The Up. phase led into a Final one with more microliths and geometrical forms.

[3] He attributes this to inadequate methods of excavation; *e. g.* use of sieves with wide holes. See his work (1933 *a*), pp. 457-483.

belonged to a fairly advanced stage of the Capsian could not be entirely excluded. At any rate, it should be made clear that although the existence of microliths in the L. Capsian would by no means constitute an unusual feature [1], it appears that in the upper and final phases of the Capsian there was a more and more marked tendency towards specialization in geometrical forms (triangles, trapezes, etc.). It is also these latter forms which, as we shall see shortly, were introduced into the other N. W. African culture of the Oranian, where the Capsian angle-burin is characteristically absent. Whether this tendency in the Upper and Final Capsian led to the establishment of a true microlithic (or Mesolithic) phase in N. W. Africa is not clear as yet. All that can be said with certainty is that the Capsian survived for a long time in Little Africa, and that at a later stage it became mixed with Neolithic elements which were presumably imposed upon it (*infra* Section III).

The distribution of the Capsian over Little Africa and the W. Sahara is rather interesting to note (compare Map 3 on Pl. III). It is curious that, strictly speaking, the true Capsian is limited to certain parts of W. Tunisia and E. Algeria [2]. In that area it has a markedly inland-distribution, as in no place does it touch on the sea [3]. In the interior of the Sahara, however, the industry seems to have been exceedingly scarce. Apart from sporadic finds the only traces of it are to be found in the region of Tabelbalat and the coast of Senegal. In the former, it is represented only by a Final Capsian (Tardenoisian-like) facies of a rather mixed character [4]. On the Coast of Dakar, on the other hand, the industry is made up of backed blades (of Châtelperron and Gravette types), backed lunates, round and thumb-scrapers,

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[1] We have already seen in the preceding Section (*supra* p. 215) that microliths were by no means confined to the late Up. and Final Palaeolithic stages. In China, for example, they occur with the Sjaro-osso-gol industry of the loess (see H. Breuil, 1928 *a*, pp. 122-130). In Egypt, on the other hand, a microlithic technique is known from historic times (see E. Baumgärtel, 1928, p. 108; also reference in A. Hertz, 1934, p. 3). It appears that many of the microlithic groups which appeared in different regions represented separate inventions and were not necessarily connected with each other. Also *vide infra,* pp. 268-269.

[2] See R. Vaufrey (1933 *a*), map on p. 458.

[3] As pointed out by E. G. Gobert and R. Vaufrey (1932 *a*), p. 489, this distribution throws heavy doubt on the question of any connection between the Capsian and the Grimaldian of Italy.

[4] See H. Breuil (1931), p. 77.

diminutive triangular points of a degenerate type and some triangular tranchets (transversal arrow-heads) and microlithic cores (*à deux talons*) [1]. So far as we could see from a rapid study of this collection, it contained neither burins nor micro-burins, though this may be attributed either to the selection by the collector or to his non-acquaintance with these types of tools. At any rate, the relative scarcity of the geometrical forms may perhaps point to the fact that it is with the L. rather than the Up. or Final Capsian that the analogies should be drawn [2].

Other Up. Palaeolithic industries of the interior of the Sahara seem to have been made up of facies derived from the Atirian or a degenerate form of it. In recent years, however, H. Breuil has distinguished a new facies in the region of Ounan (N. of Tumboktu) which he calls Ounanian [3]. The industry is almost entirely made up of long blades (sometimes with lateral notches) and tanged or shanked blade-points, which usually have a median ridge giving them a triangular cross-section (compare Pl. XVI, Nos. 1-7). The retouching is usually bold and steep, and the tangs are sometimes made by two notches opposite each other near the base. There are also rare prisms or *limace* borers with a somewhat trihedral cross-section. In virtue of its being a blade facies, this industry is placed by Breuil in the Upper Palaeolithic. It should be noted, however, that even if we accept this classification, the fact remains that this facies differs from any other Up. Palaeol. known. So far as the material, thus far available from the region, goes, it includes no backed lunates in the proper sense, no scrapers and no burins. Furthermore, we shall see in the following Section (compare also Pl. XVI, Nos. 8-20) that tanged and shanked blade-points (and also prisms) of a type similar (though rather degenerate) to that of Ounan, occur in Egypt, where circumstantial evidence excludes the possibility of their being placed in the Up. Palaeolithic phase. On the other hand, there is good reason to think that in many spots in the S. Sahara

[1] For this industry, see Collection of Trocadéro Museum (now called *Musée de l'Homme*), Paris, specimens registered as (Coll. Waterlot), Série 09.9. 1-200.

[2] It is possible, however, that this collection (which is entirely from surface) may not have belonged to a single culture. The degenerate triangular points may represent an Atirian element.

[3] See H. Breuil (1931), p. 78. For the industry itself, see Coll. of the Trocadéro Mus. (now called *Musée de l'Homme*), Paris, specimens registered 33.19.535-67.

(including the Ounan district) the Up. Palaeolithic proper was represented by a mixed Atirian-like industry including both blades, tanged and triangular flake-points and leaf-shaped points [1]. Other facies of a Final Palaeolithic appearance occur in kjökkenmoedding remains, but in all probability they belonged to a phase that corresponded to the Neolithic (or later) elsewhere. The study of these latter facies will be further taken up when we come to consider the culture-diffusions along the Sudanese Belt of the S. Sahara, and the possible connections between this latter region and the Mid. and L. Nile Valley during the most recent (*i. e.* "Neolithic") wet phase (*vide infra* Section III).

The spreading of the Capsian technique along the N. Sahara is very little known. Surface finds, usually of a microlithic character, are found here and there along the Mediterranean Belt and are generally referred to as Capsian, Final Capsian or Capso-Tardenoisian. It is not known whether these finds represented a culture directly descended from the Up. Capsian or whether they belonged to a microlithic facies of a degenerate type, in which the Capsian element was only one of several. But it is certain that the Capsian *sensu stricto* has not so far been recorded in N. Libya or Egypt (or Palestine). The Up. and Final Palaeolithic industries of N. E. Africa appear to have belonged to an autochthonous facies to which reference will be made in due course.

To the N. W. of the classical area of the Capsian (the interior of Tunisia and E. Algeria) the story of this latter culture is rather difficult to trace. It was at first almost generally accepted that the Capsian had spread north-westwards into the Tell region and the greater part of the Iberian Peninsula (S. and C. Spain) [2]. Certain authorities still even maintain that the Capsian is the ancestor of the L. Aurignacian of W. Europe and that it may have further contributed (either directly or indirectly) to the development of the Up. Aurignacian of the same region [3]. In recent years, however, the view that the movement was probably in the opposite direction has been gaining force [4].

[1] For such industry, see T. Monod (1932), pp. 150, 152 and 158; also specimen 33.19.668 in Ounanian collection as referred to in preceding footnote.

[2] See H. Breuil (1912), pp. 175 and 183; also H. Obermaier (1924), maps on Figs. 87-88.

[3] See e. g. M. C. Burkitt (1933), pp. 146-148, where only the Mid. Aurignacian is admitted as having entered W. Europe from the East.

[4] See *e. g.* H. Breuil (1931), pp. 73-74.

Of special interest is the recent work of Gobert and Vaufrey which has shown that the assumed spreading of the Capsian proper into the region of the Tell on its way to Spain can no longer be regarded with the same favour as before [1]. The industry which was first baptised (by P. Pallary) [2] as Ibero-Maurusian is now believed to have been limited in distribution to the coastal region of N. W. Africa (*i. e.* not extending into Spain). In its technique, it differed essentially from both the true Capsian and the Upper Palaeolithic facies of Spain; and H. Breuil has suggested for it the new name of Oranian [3]. It was characterized [4] by rather small or microlithic implements consisting of *lamelles à dos rabattu,* lunates, narrow blades (with lateral notches), end scrapers, little *limaces,* micro-burins and a small number of geometrical forms. Some of the cores are *à deux talons* (*i. e.* they have been flaked from two opposite ends). There are also a few triangular and tanged points of a fairly definite Atirian type [5]. This shows that, besides differing from the Capsian in not having any burins (other than micro-burins) or large Châtelperron blades (—the two most characteristic tools of the Capsian—) [6], it retained some clear Atirian affinities (of an Up. Palaeolithic type). Whether this Oranian industry was contemporaneous with the Capsian (from its early phase onwards) is a difficult matter to decide. The existence of an Atirian tradition, however, should in no way prejudice the issue, as it is not impossible that a degenerate form of this latter facies should have survived right down to the Final Palaeolithic phase. Whatever this may have been, there can be little doubt that the Oranian represented the Up. and Final Palaeolithic facies of the coastal region (including W. Morocco), and that towards its close it was largely made up of a diminutive or microlithic industry (though with few geometrical forms).

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[1] E. G. Gobert and R. Vaufrey (1932 *a*), pp. 449-490.

[2] P. Pallary (1909), pp. 45-46; also (1922), p. 371.

[3] Verbal informational kindly given by M. l'Abbé H. Breuil; also reference in Gobert and Vaufrey (1932 *a*), p. 490.

[4] For illustrations, see Gobert and Vaufrey (1932 *a*), Figs. 2-3, 8-9 and 13-18.

[5] These points occur in the L. level of the Oranian. The triangular ones usually have a prepared platform (or butt-end) and are often retouched *à la moustérienne*. The tanged points, on the other hand, show clear traces (on their upper surface) of a blade-technique, which betray their association with an Up. Palaeol. culture (for similar specimen, see our Pl. XIII, No. 2).

[6] E. G. Gobert and R. Vaufrey (1932 *a*), pp. 486-487.

Little Africa and Iberia. Contacts and Chronology.

The similarities between the Capsian and the Up. and Final Palaeolithic facies of Spain remain, on the other hand, unchallenged [1]. The angle burin (which is almost absent from the Oranian) is a characteristic implement of both. Indeed, apart from its extreme northern parts, the cultures of the whole of the Iberian Peninsula can best be classified within the Capsian group. As in the case of the true Capsian, the Iberian facies have fairly well marked similarities with the L. and Up. (Châtelperron and Gravette) Aurignacian of W. Europe, but differ profoundly from the Mid. Aurignacian of that region. Indeed it is now becoming more and more evident that the Châtelperron and Gravette sub-facies and the Capsian industries in all probability had some sort of a common origin. The difficulty arises when we come to consider whether the movement was from N. to S. or *vice versa*. The fact that the Capsian of Tunisia is not represented in the Tell region and that it was separated from Spain by a "wedge" of the Oranian may perhaps support the view that the Tunisian culture sub-area represented an "outlier" of the main culture area in S. W. Europe. If this be so, it would mean that once introduced from the North, the Capsian industry became intensively localized in E. Algeria and inner Tunisia, where it followed lines of evolution more or less parallel to those of the Mother-culture in S. W. Europe. If we prefer to think, on the other hand, that the Tunisian sub-area represented the centre from which there was a steady and regular diffusion of all the Capsian and Capsian-like (Châtelperron and Gravette) cultures towards S. W. (and ultimately W.) Europe, it would be difficult to account for the fact that the industry did not establish itself in the Tell region—the only possible land-thoroughfare for such a diffusion [2]. But this delicate question will be further referred to at a later stage (p. 264), when we come to consider the general correlations

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[1] Gobert and Vaufrey (1932 *a*), p. 488.

[2] It may be interesting to recall that we have here a parallel to the case of the assumed "homeland" of *coup-de-poing* cultures in the Indian Peninsula (O. Menghin, p. 131, also *vide supra,* Part II, Section 1, pp. 205-206). The non-occurrence (or at least extreme scarcity) of the *coup-de-poing* and associated flakes on the Iranian Plateau is more in favour of a *rapid* introduction of these cultures from the West into India than of a *steady* diffusion from the latter westwards.

(distribution and chronology) of the various industries of the Up. Palaeolithic.

The date of the Capsian is another of the many mysteries of the Up. and Final Palaeolithic of N. W. Africa. The difficulty arises from the fact that the data available come either from open-air stations or from caves which do not throw much light on the question of chronology. We have seen, however, that on the evidence of fauna, the climate must have been one of increasing desiccation until towards the end of the Capsian phase it became quite arid (*vide supra* Part I, p. 64 and Tables VII and IX). According to correlations put forward in Table XII (*vide supra* Part I), this culture should be related to the closing stages of the 2nd Pluvial (*i. e.* Bühl and its retreat phase, or more probably only the latter) [1]. This applies at least to the typical Capsian *escargotières* and shelter-settlements from which identifiable faunal remains are available.

Summary of Upper Palaeolithic in Little Africa and W. Sahara.

If we may now sum up the story of the Up. Palaeolithic in the W. Sahara and N. W. Africa, we find that some of the cultures of the late Middle Palaeolithic seem to have survived right through the Upper, and even into the Final Palaeolithic. Atirian forms are found mixed with or affected by a blade technique in various places of the W. Sahara. They also spread into Cyrenaica and as far as Egypt and Palestine [2], where they may be dated, stratigraphically, to the Upper Palaeolithic. In W. Morocco and along the coast of the Tell region a retarded Atirian facies persisted into the early stages of the Oranian. It is not ascertained as yet, however, whether the Atirian was diffused into the Iberian Peninsula to any appreciable extent.

The Capsian *sensu stricto* was limited to a small area in the interior of Tunisia and E. Algeria. At first, it was characterized by a relatively massive industry, together, apparently, with some microliths; but towards its close microlithic and

[1] At any rate, it is now almost certain that the Capsian of Tunisia was later in date than the L. Aurignacian of W. Europe (which corresponded to the early part of Achen). Of course, this must be remembered in dealing with the question of the spreading of Capsian-like cultures.

[2] *Supra*, pp. 220, 226 and 235. Roughly tanged Atirian-like points also occur in a surface collection (uncertain date) from Khirbet Bustan, Palestine; Völkerkunde Mus., Prähist. Abt., Berlin, regist. XI *c* 1303.

geometrical forms became more and more abundant. Its influence was felt in certain parts of the W. Sahara (especially Tabelbalat) and as far as Senegal; but in these areas it was not represented in its pure form. The same may be said about the possible spreading of Capsian influences eastwards; and in any case, no true Capsian has thus far been found either in Egypt or in Palestine. As to the coastal region of the Tell, it was occupied by a distinctly divergent industry — the Oranian. This latter formed a "wedge" between the Capsian of Tunisia and the closely similar industries of S. and C. Iberia. It is not known with certainty, as yet, in which direction the Capsian industries spread; but the weight of evidence at present is in favour of the facies having come from the Iberian Peninsula. The date of the Capsian of Tunisia may be *roughly* correlated with the Bühl (and chiefly its retreat phase).

N. E. AFRICA. EGYPT IN THE UPPER PALAEOLITHIC.

There remains for us to consider only the N. E. corner of Africa. As we have already seen in the preceding Section (pp. 221-223), this region had its own local facies at the close of Mid. Palaeolithic times. Acheuleo-Levalloisian and Levalloisian tradition continued here probably longer than in any other part of the Old World [1], while Mousterian influence was felt hardly at all. It has also been mentioned, however, that this continuation was of a progressive type, and that it did not represent a degenerate or stagnant survival. In fact, it was destined ultimately to form the base for the Up. Palaeolithic facies of the region. Perhaps the best approach to the study of these latter facies and their evolution will be to start with a brief survey of their technological character and distribution (beginning with S. Egypt where the culture has been first known).

The Sabylian of Kom Ombo (S. Egypt). Its Derivation and its Development.

Thanks largely to the work of Ed. Vignard the Sabylian (*Sébilien*) culture has now been definitely established [2]. This industry differs essentially from both the Aurignacian and the Capsian in the fact that it starts as a "flake"

[1] Of course not taking into account such remote and corner regions as S. Africa.

[2] See his work (1923), pp. 1-76 (where he first recognized the culture and baptized it); also (1928), pp. 200-220.

rather than a "blade" facies. According to Vignard, the lowest level of the Sabylian (*Sébilien I*) is little more than a diminutive form of a so-called "Mousterian" [1]. It is almost entirely made up of small (Diminutive) Levallois discs (or discoïdal cores with neat preparation for flaking), and small simple Levallois flakes with facetted platform (compare also our Pl. XII, Nos. 9-11). A few flakes show slight trimming on side or tip, but it is clear that this retouch has nothing to do with the true Mousterian technique [2]. In the Middle level (*niveau II*) of the Sabylian, however, the Mid. Palaeolithic tradition is no longer so pronounced as before. Indeed, it is at this stage that the typical Sabylian technique starts [3]. The industry is made up of small (Diminutive) but well prepared Levallois cores, small simple points, retouched points, lunate-like blade-points, scrapers of various descriptions, triangles, etc. Some of the cores are *à deux talons, i. e.* they have been flaked from two opposite ends. This is a type of fracture which was in fact, older than the typical (Mid.) Sabylian; but from that level onwards it became especially characteristic of the Up. Palaeolithic of Egypt [4]. Blades are not lacking, but the industry is predominantly one of flakes [5]. The trimming is steep and resembles *mutilation* (in order to render the edges less fragile) rather that sharpening. It may be argued that this technique was rendered necessary by the delicacy of the implements; but such an explanation could by no means apply to all the specimens. We shall also see, a little later, that the same technique was applied at an earlier stage than the Mid. Sabylian, when implements were more robust. Another unique feature of the typical (Mid.) Sabylian is the deliberate breaking off of the bulbar end or the tip, or of both, and the subsequent retouching of

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[1] Or *éclats levallois du moustérien* to use his term. On this level see his work (1923), pp. 5-13 and Pl. I-V; also (1928), pp. 200-203 an Pl. I-IV.

[2] This has been ascertained from the study of the Sabylian collection of the Geogr. Dept., Fuad I University, Cairo; also of Coll. of Ed. Vignard in Paris.

[3] On this level, see Ed. Vignard (1923), pp. 13-29 and Pl. VI-XIV and (1928), pp. 203-207 and Pl. V-XII. See also our Pl. XII, Nos. 13-18.

[4] This technique was probably intented to produce short flakes. For such specimens of cores, see our Pl. XI, Nos. 1, 4 and 10-12 and Pl. XII, No. 13.

[5] The term *blade* is here used to denote *narrow and elongated flakes*. On the difference between the two terms of *blade* and *flake*, also *vide supra,* footnote 5, on p. 215.

the break-line [1]. The break-lines (or *troncatures*) are usually at right angles to the axis of the flake, but sometimes they are oblique. It is argued with some reason that, at least in case of butt-truncation, the severing of the bulb was intented to produce a better hafting base [2]. The secret of this technique of shortening, mutilation and steep blunting remains, however, largely unfolded. The flakes and flake-fragments appear to have been used both as points and as scrapers. We also have at this stage a marked tendency towards backed-blade types (*i. e.* large lunates but not true Châtelperron blades), triangles and trapezes. There are also some true medium or small lunates. But it is interesting to note that the burin is entirely absent [3]. This draws another marked line of distinction between the Sabylian, on the one hand, and the Aurignacian and Capsian, on the other. It is all the more interesting, because it has been recently claimed by Vignard that the technique of the micro-burin (which later on became a very characteristic feature of late Up. Palaeolithic and Final Palaeolithic cultures in many parts of the world) may be traced (though not in true micro-burin forms) to this Middle stage of the Sabylian [4].

The third (uppermost) level of the Sabylian is essentially a continuation and perfection of the industry of level II [5]. The tendency towards a microlithic industry is now well marked in both the cores and the flakes. Instead of having their striking platform elaborately faceted (as in the case of true discs), some of the cores have their platforms prepared by a single blow (*i. e.* a plane transversal facet) [6]. This is a Final Palaeolithic (Mesolithic) rather than a

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[1] For this technique of deliberate shortening or mutilation, see Ed. Vignard (1928), Pl. VII-X. Also specimens of bulbar, median and terminal fragments in our Pl. XII, Nos. 4-7, 12, 14-16 and 20-23.

[2] See Ed. Vignard (1923), pp. 33-34.

[3] Ed. Vignard (1923), pp. 20-21 and (1928), p. 205.

[4] Ed. Vignard (1934), pp. 92-103. If this be so it would mean that the micro-burin had a different ancestry from the burin proper. This is quite feasible; but it should be made clear that Vignard's conclusions about the spreading of the micro-burin technique from the region of Sabyl (Kom Ombo) to all other parts of the Old World, where it has been found, is much too far-fetched (*vide* a little *infra*).

[5] On *niveau III,* see Vignard (1923), pp. 29-62 and Pl. XV-XXIII and (1928), pp. 207-215 and Pl. XIII-XX. Also our Pl. XII, nos. 19-32.

[6] For this type, see Vignard (1928), Pl. XIII, Nos. 6-9. Also our Pls. XII, 19 and XI, 12.

true Up. Palaeolithic feature. The deliberate mutilation (truncation) and blunting of the flakes continues. Microlithic points (some having a lateral shank), triangles, trapezes, lunates, little "*lamelles*" (with or without lateral notches), scrapers and bone points occur. The micro-burins are a special feature of this phase. Indeed, it is on the strength of this implement that Vignard bases his assumption that the Kom Ombo Basin was the centre of dispersal for the whole of the Final Palaeolithic (Mesolithic) cultures of the Old World [1]. This rather bold view will be referred to a little later; but it should be made clear that in spite of similarities with the outside world, the upper level of Sabyl has certain well marked local features. Its spreading within Egypt itself must be regarded with more caution than is usually assumed. K. S. Sandford claims to have discovered it (together with earlier Sabylian facies) in such widely separated parts of the country as Fayyoum and Nubia [2]. To judge from his illustrations (which must represent his best specimens), however, the resemblance of these finds to the true industry of Sabyl appears to be rather superficial [3]. His material from the Fayyoum seems to belong to a certain "Diminutive Levallois" industry, to which reference will shortly be made, while his Nubian material is made up of little "*lamelles*" which represent a degenerate form of Sabylian [4]. Indeed we may safely conclude that although Up. and Final Palaeolithic finds from other parts of Egypt bear certain similarities to the Sabylian, they also show their own regional characteristics. This point which throws much doubt on the hypothesis put forward by Vignard, will be made clearer when we come to consider the Up. and Final Palaeolithic of Middle and N. Egypt.

The date of the Sabylian offers another difficulty. Unfortunately the faunal

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[1] See Ed. Vignard (1923), pp. 75-76 (1928), pp. 219-220; and (1934), pp. 66-67 and 100-103.

[2] See K. S. Sandford and W. J. Arkell (1929 *d*), pp. 52-65 and Figs. 22-25; and (1933), pp. 48-52 and 79-80 and Pls. XL-XLII.

[3] See also reference to the typological ambiguity of Sandford's Sabylian material in G. Caton-Thompson and E. W. Gardner (1934 *b*), p. 10.

[4] This latter point has been confirmed by a rapid review (by present writer) of Sandford's material at Oxford (Geol. Mus.); and by study of an interesting (though much mixed) collection from Wadi Halfa in the Manchester University Mus. (regist. S. Archer. O.2017).

remains can throw only a limited light on the matter [1]. The specimens thus far identified included hippopotamus and various fishes. These may perhaps be taken to indicate swampy conditions in the Kom Ombo Basin especially during Levels I and II. It should be noted, however, that recent work by Sandford and Arkell has shown that the high waters of this basin during early Up. Palaeolithic times were due to a phase of aggradation of the river (*vide supra* Appendix A, to Part I), and that consequently the abundance of water in the basin may not necessarily have been due to abundant rainfall during that phase. It is at any rate agreed that towards the close of Sabylian times, the climate became drier and drier until finally semi-desert conditions were established. If the correlations put forward at the close of Part I be accepted (compare also Diag. 6, Pl. V), the Sabylian of Up. Egypt would be dated to the close of the 2nd Pluvial (*i. e.* most of Bühl, but chiefly its retreat phase).

The Pre-Sabylian (Archaïc Sabylian?) of Khargah Oasis.

Another part of Egypt where a culture with Sabylian affinities has been discovered is Khargah Oasis. In silts immediately underlying the lowest Wadi Tufa (see Diag. 4, A and B, Pl. V) of the Khargah Scarp (and also on surface) were found implements which Caton-Thompson describes as "Pre-Sabylian" [2]. As may be seen from illustrations on Pl. XII 1-7, this industry is made up of small tortoise cores (some being *à deux talons*) and small flakes with exceptionally steep blunting. The flakes are sometimes more in the blade tradition than those of Sabyl [3]. They are often deliberately mutilated and contain retouched

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[1] See Ed. Vignard (1928), pp. 203, 207 and 216. More recently, however, K. S. Sandford (1934), p. 86, has been able to determine a fair number of Sabylian fauna. These indicate that although the climate may have been relatively dry, it was far from being of a desert type.

[2] See G. Caton-Thompson (1932), pp. 130-131 and G. Caton-Thompson and E. W. Gardner (1932 *a*), pp. 393-395 and 404.

[3] It should be noted, however, that the Levalloisian industry (from which the Pre-Sabylian was evidently derived) contained some narrow blades besides broad flakes (compare Pl. X). The existence of blades in the Up. Palaeolithic of certain parts of Egypt should not therefore necessarily be interpreted as denoting an introduction from without.

terminal, median and bulbar fragments. The line of truncation (or transversal break), however, was not always retouched. These flakes and fragments could have been used as points, knives, end scrapers, hollow scrapers (*encoches*) etc. There can be little doubt that this industry is a direct descendant from the Levalloisian [1]. Although it exhibits some distinctly new features (*e. g.* smallness of artifacts, truncation and steep blunting) the method of flaking remains essentially Levalloisian. The fact that the Pre-Sabylian has been found at a lower stratigraphical level than the Atirian [2] helps to date it to an early phase of the Up. Palaeolithic (or perhaps the transition from the Mid. Palaeolithic). According to various interpretations of physiographic evidence, it may be placed either just before the last sub-maximum of the 2nd Pluvial (*i. e.* Bühl) or immediately after it [3]. This culture, however, was apparently not destined to last or develop further in Khargah. Unlike the facies of Kom Ombo, the Pre-Sabylian of Khargah did not develop into a microlithic technique. As it shows no signs of degeneration, however, it is possible that the people either migrated from the area, or were simply driven away by the arrival of others (such as the Atirians?) from the West. But it should be made clear that in spite of its having been—rather unfortunately—labelled "Pre-Sabylian" [4], this industry could in no way be regarded as the prototype of the Sabylian proper. In this respect it may be useful to remember that the typical Sabylian (level II) has its own local connection with the Levalloisian in the form of the industry of level I (with which the facies of Khargah could not be strictly paralleled). On the other hand, the existence of a certain (very little known, and thus far collected only from surface) core and flake industry, in deserts bordering the Nile Valley opposite the Khargah Oasis, may perhaps serve as an indication that we are dealing

[1] On this basis, G. Caton-Thompson (for reference *vide supra* footnote 2 on preceding page) places this industry in the Mid. Palaeolithic. We prefer, however, to place it at the base of the Up. Palaeolithic (or perhaps the transition from the Mid. Palaeolithic).

[2] See G. Caton-Thompson (1932), p. 131.

[3] The first alternative being perhaps the more likely one. Also *vide supra,* Part I, pp. 91-94.

[4] The writer is made to understand that G. Caton-Thompson herself now prefers to change this name, though the question remains suspended. Could it be permissible to substitute the denomination "Archaïc Sabylian"?

here with another zone of this peculiar [late Middle (?) and] Up. Palaeolithic of Egypt (also *vide infra,* pp. 261-262 and footnote 1 on p. 262) [1].

The Diminutive Levalloisian (Up. Palaeolithic) of N. Egypt.

A similar type of the Upper Palaeolithic technique is also found on the desert surface in N. Mid. Egypt and on the S. borders of the Delta [2]. Here, however, the industry appears to have slightly more blade-affinities than in the South. This is shown by the existence of long flakes or blades which make their first appearance in the true Levalloisian of the region. The industry is represented fairly extensively on both the W. and E. sides of the Nile. Of particular interest are the surface localities, bordering Delta and Valley, where large numbers of small tortoise cores have been discovered. The fact that these cores were not associated with any of the ordinary large tortoise type of the Acheuleo-Levalloisian and Levalloisian phases may indicate that they represented a definite culture phase of a diminutive industry, and were not simply stray specimens of the small types that occur sporadically in late-Lower and Mid. Palaeolithic times. From the material we have at hand we may assume the existence of an industry which may be described as "*Diminutive Levalloisian*" [3], and which was derived from (and also later than) the true Levallois. Indeed the existence and technological identity of such a culture phase in Egypt is no longer to be doubted. The industry has been discovered *in situ* in various parts of the Nile Valley and

[1] Some specimens from the region of Thebes bear certain resemblances to the Pre-Sabylian of Khargah; Coll. of the Praehist. Abt. of the Völkerk. Mus. (Berlin), registered X 1067-1072.

[2] For specimens from the W. of the Nile (N. of Fayyoum) see Coll. of Geogr. Dept., Fuad I University, Cairo. For the East of the Delta see Coll. of Deutsch. Inst. f. aegypt. Altertümskde, Cairo (Ostdelta Reise 1930). In a previous publication (Huzayyin, 1939 pp. 210-211 and Pl. II) we have referred to a surface station discovered by O. Menghin (and others) in Wadi ʿAngabyyah, 25 km. N. E. of Cairo, as representing an Up. Palaeol. facies. In a very recent visit to the site, however, we have been made to believe that the surface finds, there, are so mixed with later material that it would be unsafe to date them. Dim. Lev. cores and flakes do exist, but they are in minority and sometimes exhibit the same patination as later material. It is possible, *e. g.*, that Nos. 26-28, on Pl. II (*ibidem*) may represent Pre-Dynastic specimens.

[3] On this industry and its appellation see S. A. Huzayyin (1939), pp. 207-208.

outside it. We may mention, for example, the 28 m. and 24 m. (above sea-level) beach deposits of the Old Lake of Fayyoum (our Pls. X and XI) [1], the Nile terrace deposits of Zawiyat Abu Musallam, South of Gizah [2], the gravel-spread (or gravel-wash?) of Abu Suwair near the E. end of Wadi Tumilat [3] and what appear to be terrace and deltaic (wash?) deposits in some of the dry wadis of the E. Desert, S. of Cairo [4]. This Diminutive Levallois industry which appears to be especially abundant in N. Egypt, corresponds to the whole of the Sabylian of Kom Ombo (including presumably also the so-called Pre-Sabylian of Khargah). The main difference is that while in the North the facies included both broad and relatively narrow flakes (or blades; our Pls. X, and XI, various specimens), the former type became more and more abundant southwards. As in S. Egypt, however, the Up. Palaeolithic of N. Egypt appears to have been directly derived from the Levalloisian. In the deposits of the 28 m. beach in Fayyoum both Levallois and Diminutive Levallois forms are found (the latter appearing to be in minority). In later deposits, the Diminutive Levallois facies (cores, flakes and blades) becomes more characteristic and represents the true Up. Palaeolithic of N. Egypt. An interesting locality, with numerous finds *in situ,* has been recently (1940) discovered by Pilot Officer R. Grace near Abu Suwair [5]. A small series of its artifacts are represented on our Pl. XI,

[1] Implement collections made from these deposits by K. S. Sandford and W. J. Arkell (1929 *d*) and by Caton-Thompson, Gardner and Huzayyin (see Huzayyin, 1939, p. 208, footnote 2). Also collections from the 28 m. beach by S. Huzayyin and students of the Geography Dept., Fuad I University, Cairo. The material from this 28 m. beach (equivalent of 3 m. terrace in Nile Valley?), however, represents both (Late?) Levallo isand Diminutive Levallois (Pl. X and explanatory note). The material found by Caton-Thompson, Gardner and Huzayyin still awaits publication by the discoverers. References made to it here can only be regarded as preliminary. The present writer is indebted to Misses Caton-Thompson and Gardner for kind permission to deal, in passing, with part of this material, and also for many valuable suggestions while working with them in the Fayyoum in the winter of 1937. The material is now kept in the Geogr. Dept., University, Cairo.

[2] K. S. Sandford and W. J. Arkell (1939), pp. 54-56 and Pl. XXIII-XXIV.

[3] K. S. Sandford and W. J. Arkell (1939), p. 90 and Pl. XXV. Also *vide infra.*

[4] See S. A. Huzayyin (1939), p. 208, footnote 2.

[5] The site lies at 1700 metres to the North of Abu Suwair Station (*i.e.,* N. E. of the airdrome) (see Map on Pl. XVIII). A cutting was made, some years ago, through a little raised ground belonging to a gravel-spread (or wash ?), in order to make a road (now abandoned). Artifacts were discovered *in situ* on both sides of abandoned trench. The site and its vast collection will be dealt with more extensively in a forthcoming publication by the present writer.

Nos. 10-25. It will be seen from these illustrations (and also from those of Fayyoum material, on Pls. X and XI) that the Diminutive Levallois facies represents a simple continuation of true Levalloisian technique. There are large numbers of small cores, some of which being *à deux talons* (*i. e.,* flaked from opposite directions, Pl. XI, 1, 4, 10 and 12) or quite discoidal in form (Pl. XI, 11). The system of striking flakes off cores appears to have often aimed at producing little and short flakes, often with broad end. As in the Levalloisian stage, some of the flakes show at their broad end (terminal edge, opposite to bulb) scars of the preparation flaking or chipping belonging originally to the dorsal face of the core from which they have been struck off (compare Pl. X, Nos. 4-6 with Pl. XI, Nos. 3, 6 and 15). Small narrow blades also occur (Pls. X, 10-12 and XI, 7 and 18-19). These, however, are different from the blades of either the Aurignacian or the Capsian, and they give the impression of being more in line with Levalloisian tradition. Side (and end) trimming is also very rare, and when it occurs it is usually of the steep type [1]. This scarcity of secondary retouch is true of both Fayyoum, Abu Suwair and other material from N. Egypt, and it draws a marked line of distinction between the Up. Palaeolithic facies of the North and those of the South of the country. The progressive character, which the Egyptian Levalloisian showed in late-Middle Palaeolithic times (*vide supra,* pp. 228 and 251), and which continued in S. Egypt nearly to the close of the Sabylian, does not seem to have been maintained in the Upper Palaeolithic of N. Egypt. So far as present discoveries go, the Diminutive Levallois (of the North) is singularly poor as regards the variety of its tool-types. This contrasts with the much richer variety of tools in the Up. Palaeolithic (Aurignacian) of such a neighbouring country as Palestine. We may note in particular the absence (at least from the material *thus far discovered*) of the burin (compare also *supra,*

[1] The partly retouched specimens drawn on our Pl. XI, Nos. 20-23 represent the best known from a collection of several hundred flakes, blades and chips from Abu Suwair.

p. 253) or even the true knife-blade *à dos rabattu* (found, however, in the Sabylian). Towards its close, however, the Diminutive Levalloisian appears to have tended towards microlithic forms (Pl. XI, 8-9, 17-21 and 23-25). Apart from microlithic flakes and chips, it may be interesting to note that a few of the small cores found at Abu Suwair exhibit the simple striking platform (usually produced by a single facet) so characteristic of the Final Palaeolithic (Pl. XI, 12; similar to Pl. XII, 19). Indeed, it was perhaps from this Diminutive Levalloisian that the microlithic (partly Final Palaeolithic? and certainly later) facies discovered on the surface (and so of rather uncertain date) at Hilwan and Wadi ʿAngabyyah (Pl. XII, 33-45) was evolved (though only indirectly) [1]. This latter facies shows a preponderance of small blades, which are either left simple or retouched into lunates and *lamelles à dos rabattu*. The trimming on their back is usually steep. This industry, however, is poor in the variety of its tool-types. Apart from triangles it lacks true geometrical forms; and in this differs from both the Final Capsian and the uppermost Sabylian. As a microlithic facies, it (or at least its Hilwan sub-facies) seems to bear a certain resemblance to the Natufian of Palestine, though this latter was somewhat more specialized [2]. As we shall see in the following Section, it is probable that both the Natufian and the Hilwan (and Wadi ʿAngabyyah) facies survived well into Neolithic or even Post-Neolithic times [3].

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[1] For the industry of Hilwan see Coll. of British Museum (London), presented by Dr. Riel and regist. as 1916. 6-5. 164 and 165; Coll. of al-Mat-haf al-Misri (Egyptian Museum, Cairo), specimens registered: Amin al-ʿUmari, 50065-50204, and Seton-Karr 1900. The site at Wadi ʿAngabyyah (N. E. of Cairo) was discovered by O. Menghin and others (*vide supra,* footnote 2 on p. 257); see Coll. of Geography Dept. (or Section), Faculty of Arts, Fuad I University, Gizah, regist. as Wadi ʿAngabyyah.

[2] On these similarities see work of D. A. E. Garrod (1932); also *vide infra* Section III. The more specialized character of the Natufian is illustrated by the existence among its tools of crescents with inverse trimming (instead of blunting) on their back. This gives them a ridged back instead of a flat one. Very few such specimens occur at Hilwan (*e. g.* no. 52815 in Egyptian Mus. Cairo) and none at Wadi ʿAngabyyah. (Also *vide infra,* pp. 289-290.)

[3] In fact the Hilwan station has a mixed character and contains what may be regarded as Neolithic (or later) types; see J. de Morgan (1926), pp. 68-69 and P. Bovier-Lapierre (1926 *a*), p. 304. It should be also made clear that there is still an unknown gap in technological evolution between the late Diminutive Levallois and this industry of Hilwan.

Summary of Upper (and Final) Palaeolithic in Egypt.

If we may now summarize the story of the Up. (and Final) Palaeolithic in Egypt we find that, as in the case of the Middle Palaeolithic, these later (Up. and Final) cultures offer certain well marked regional characteristics. So far as can be judged from its technology, the Egyptian Up. Palaeolithic sprang directly from the Mid. Palaeolithic of the region and does not seem to have felt outside influences to any extent. From the very beginning it had a facies characterized by small Levallois cores and flakes (and blades), which we have proposed to call as the "Diminutive Levallois". Some of the cores are *à deux talons,* and this had the effect of producing short flakes (and small blades). That this facies formed a distinct phase of its own has been proved by the discovery *in situ* of culture-horizons belonging to it. Its identity may be also judged from the fact that wherever its cores and flakes occur in any numbers on the surface, they are not found associated with any of the ordinary large types of the Levallois proper. This excludes the possibility of regarding them as representing small types of Levallois cores, discs or other implements occurring in ordinary Levallois times (just as a certain number of small *coups-de-poing* occur within the ordinary Acheulean). These cores and flakes have thus far been found from Kom Ombo in the South to Wadi Tumilat in the North. We may, therefore, be justified in regarding them as representing a distinct culture phase starting late in the Mid. Palaeol. and continuing into the Up. Palaeolithic of Egypt [1]. It should be made clear, however, that right from the very beginning, the factor of "regional specialization" played a marked part in the evolution of this culture. So far as we know at present, there were three main sub-areas of Diminutive Levallois (and derived industries) in Egypt: the Kom Ombo Basin in the

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[1] We may note, however, that an industry very similar to the Diminutive Levalloisian is also known from certain surface stations in Palestine (especially Khirbet Bustan). See coll. of the Prach. Abt. of the Völkerkunde Mus. (Berlin), specimens regist. (Sammlung Brotzen) X*c* 1303, 1377, 1407-1408, 1410-1411, 1438-1439, 1446, etc. In contrast with the sequence in Egypt, however, this industry does not seem to have continued into the Up. Palaeolithic. So far as we know, no trace of it was found in the caves and it was not associated with the Aurignacian.

South, the Khargah (and the opposite parts of the Nile Valley)[1] in S. Middle Egypt and the Fayyoum and the borders of the Delta in the North. While Kom Ombo was more especially characterized by flakes, N. Egypt showed a more marked tendency towards a blend of flakes and blades (though the latter remained always in minority). The Southern facies (or sub-facies), however, became much more progressive than the Northern one, in which the Diminutive Levalloisian gradually lost its original progressiveness and became somewhat stagnant and poor in retouching technique and in the variety of tools. So far as the material *thus far* discovered goes, the Northern facies became limited to mere cores, flakes, little blades and chips with hardly any lateral retouch at all. The South Egyptian (Sabylian) facies, on the other hand, retained its progressiveness for some time, though it was marked by steep trimming, which developed into blunting, truncation and mutilation of artifacts. The so-called Pre-Sabylian of Khargah was nearer the Southern facies than the Northern one, but it came to an abrupt end in the Khargah region (perhaps on the invasion of the Atirians from the West?)[2]. It is further interesting to note that although the N. and the S. facies of the Egyptian Up. Palaeolithic have graded (or degenerated?) into a microlithic stage[3], they did not follow strictly identical lines of evolution. The same

[1] A collection of Diminutive Levalloisian and Pre-Sabylian appearance has been made from high desert surface near Abydos, and was for some time kept in the Carl Pearson Museum, University College, London. It has now been removed to the Institute of Archaeology, St. John's Lodge, Regent's Park, London (registered as Desert surface, Abydos, Nos. 1-136).

[2] It may have persisted, however, in opposite parts of Nile Valley (*vide* preceding footnote).

[3] It should be made clear, however, that the story of technological evolution of the Up. Palaeolithic in N. and S. Egypt (as worked out in the preceding pages) should be regarded as only provisional and subject to future corrections. The discoveries from the North are still incomplete and may not represent the whole story; — *e. g.* there is still an unknown gap between the Diminutive Levallois and the microlithic industry known from Hilwan (Post-Neolithic in date? *vide supra,* footnote 3 on p. 260). Also the Sabylian of Kom Ombo has been found by Vignard either on the surface or in profusion on the surface. It is true that the discoverer (Vignard, 1923 and 1928) has based his three stages (Levels) of the industry (*vide supra,* pp. 251-255) on what he considered to be sufficiently definite physiographic evidence; but it should be admitted that a technological sequence based entirely on surface material must remain subject to modification as a result of the discovery of any material *in situ* in the future.

factor of regional differentiation continued to act in the Final Palaeolithic, with the result that the microliths of Kom Ombo and other southerly stations could not be paralleled with those of the North (Hilwan, etc., known only under a *surviving* form). Although, after the establishment of desert conditions, the Nile continued to facilitate migrations, there seems to have been little further cultural contact between N. and S. Egypt. In this phase of desiccation the Sabylians (or rather a degenerate branch of them) seem to have followed the river southwards (?) in the direction of Wadi Halfa, while the peoples of the North (Hilwan, etc.) may have established some relation with Palestine (though the nature of this is not quite clear as yet). It is also practically certain that the facies of Hilwan could only have been *indirectly* derived from the Up. Palaeol., and that it persisted right into Neolithic and even Post-Neolithic times. But this takes us well beyond the limits of the Final Palaeolithic and we propose to leave the question for further discussion in the following Section.

Judging by the evidence of climate and also by physiographic data recently obtained from Khargah, the Up. and Final Palaeolithic of Egypt may be placed roughly in the closing stages of the 2nd Pluvial (*i. e.* equivalent of Bühl; including later part of Achen?) and the ensuing phase of increasing aridity.

GENERAL SUMMARY OF CULTURE COMPLEXES AND CONTACTS IN THE UP. (AND FINAL) PALAEOLITHIC.

In the foregoing paragraphs we have completed a brief survey of the distribution and technological inter-relations of the various cultures of the Up. and Final Palaeolithic of the Old World. These, together with their approximate chronological status are given in a summary form in Table XVII. It is clear from this latter that the various facies did not start or finish exactly at the same time in the different regions. None-the-less, it is evident that they all corresponded roughly to the closing stages of the Pleistocene. So far as the technology is concerned, however, it has been shown (as may be also gathered from our Map 3) that the cultures were not strictly identical either in their origin or in their lines of evolution. It is clear that the Aurignacian (and associated facies) are by far the most wide-spread. In various parts of the Asiatic Steppe

there is an atypical facies which was in all probability derived from the still less specialized flake or blade culture of the Mid. Palaeolithic. It is not known definitely as yet whether this constituted the main stem from which the Aurignacian was evolved; but it is probable that at an early date a certain blade facies spread (from the Asiatic Steppe) westwards and south-westwards about the same time as (and perhaps in company with) the Mousterian. This early facies has thus far been traced in W. Europe (France), Palestine and E. Africa. The Aurignacian of W. Europe, however, seems to have had its immediate proto-type in the Primitive Aurignacian of the C. and E. C. parts of that Continent [1]. This culture reached the extreme western borders of the Continent in two distinct waves : 1) the L. Aurignacian (from which the Up. Aurignacian was presumably derived, later on); and 2) the Middle (typical) Aurignacian, which appeared as a "wedge" between the L. and Up. phases of the culture. It is interesting, however, that the Mid. facies was felt neither in Italy nor in Iberia (except for the extreme North). The peninsular character of these two extensions of the European Continent had a marked effect upon the evolution of their cultures. This applies particularly to Italy with its Grimaldian facies, which represents a development in a *cul-de-sac,* though it had some relations with Krems and Willendorf in Austria. C. and S. Spain, on the other hand, developed a facies which was in all probability derived from the L. Aurignacian (or a kindred facies) of W. Europe, but which had gradually assumed a Capsian character. The similarities between this Spanish facies and that of Tunisia have led to the assumption that the Iberian Peninsula (or even the whole of W. Europe) received their earliest Up. Palaeolithic cultures from N. W. Africa. The weight of evidence at present makes it safer to think of the expansion as having been in the opposite direction. There

[1] Does this mean that *Homo sapiens* type, whose remains have always been found with the Aurignacian (whenever this latter has yielded any bones), started in this region of the European loess? And that, consequently, the earlier blade culture of Asia proper may not have necessarily been associated with this type of Man? Furthermore, is it permissible to think of a *H. sapiens* group as having originated or arrived in E. C. and E. Europe where it adopted an Asiatic blade culture which was not its own? All these are interesting possibilities, but unfortunately the material at hand does not warrant our being any more precise. On some of the racial problems of the Up. Palaeolithic, *vide infra,* the Addendum to the present Section.

TABLE XVII.

Tentative Chronological Table of the Up. and Final Palaeolithic cultures of the various zones of the Old World (based on references mentioned in footnotes of present Section). (The Table reads upwards and no time-scale is attempted.)

Abbreviations : Dim. Lev. = Diminutive Levallois; Sab. = Sabylian; (Prim.) Aur. = (Primitive) Aurignacian; (Pro.) Sol. = (Proto-) Solutrean; Mag. = Magdalenian; At. = Atirian; Cap. = Capsian; Or. = Oranian; Inter-Cap.-Neol. = Inter-Capso-Neolithic; Still. = Stillbay; Element. = Elmenteitan; Nat. = Natufian; L., Mid., Up. = Lower, Middle, Upper; Fin. = Final; Pal. = Palaeolithic; Neol. = Neolithic; K. = Kenya.

<table>
<tr><th>GLACIALS.</th><th>C.-E. AND C. ASIA.</th><th>C. AND E. EUROPE.</th><th>W. EUROPE.</th><th>PALESTINE.</th><th>E. AFRICA.</th><th>N. W. AFRICA AND W. SAHARA.</th><th>EGYPT.</th><th>PLUVIALS.</th></tr>
<tr><td>Climatic. Optimum.</td><td></td><td>Fin. Pal.?</td><td>Fin. Pal.?</td><td>Nat. and Eneol.</td><td>Wilton. Element.</td><td>Inter-Cap.-Neol.</td><td>Neol. and Post-Neol.</td><td>Neol. wet phase.</td></tr>
<tr><td>Post-Glacial.</td><td>?</td><td></td><td></td><td>?</td><td>Still. and Late K. Aur.</td><td>Or. / Late At. / Early At. ? — Cap. / ?</td><td>Fin. Pal.</td><td>Post-Pluvial (dry).</td></tr>
<tr><td>Bühl.</td><td rowspan="3">Atypical flake and blade industries.</td><td>Up. Pal.?</td><td>Mag. / Sol.</td><td rowspan="2">Aur.</td><td>Still. and Up. K. Aur.</td><td rowspan="3">Late At. / Early At. ? — Cap. / ?</td><td>Mid. Sab. / Dim. Lev. and Pre-Sab.</td><td rowspan="3">and Pluvial.</td></tr>
<tr><td>Achen.</td><td>Prim.-Aur., Aur. and Pro.-Sol.</td><td>Aur. and Sol. / Aur.?</td><td>L. K. Aur.</td></tr>
<tr><td>Würm.</td><td></td><td></td><td></td><td></td></tr>
</table>

can be little doubt that the Capsian of Tunisia was somewhat later in date than the lowest Aurignacian of W. Europe. Furthermore, we have seen that it had no direct relation with any of the previous (late Mid. Palaeolithic) facies of N. Africa; so that it could not be readily regarded as autochthonous. In fact we have also seen that the Atirian technique continued to flourish

side by side with the Early Capsian, and was even able to exert a marked influence upon the development of the Early Oranian of the N. W. African coasts. The very existence of this Oranian "wedge" between the Capsian zone of E. Algeria and W. Tunis on the one hand, and the Spanish zone on the other, makes it more difficult to accept the possibility of a regular culture-diffusion between these two zones in one direction or the other. It would be particularly absurd to think that the main sub-facies of the Aurignacian-Capsian industries had first started in Tunisia, and then spread into Spain and other parts of W. Europe (during the L. and the Up. Aurignacian phases) without having affected to any really appreciable extent the industry of the Tell and Rif region (compare our Map. 3 on Pl. III). On the other hand, it would be quite feasible to think that, on advancing from E. Europe the L. Aurignacian (Châtelperron) was first established in W. Europe (France), then spread into Spain (perhaps under pressure from the Mid. Aurignacian which was advancing from C. or S. E. Europe?) through which it finally reached Tunisia. The close similarities between the Up. Palaeolithic of Spain and of Tunisia may be attributed either to the fact that when the spread of the culture into the latter region took place, the industry was already fairly well evolved (*i. e.* with microliths, etc.—if Vaufrey's new observations become definitely corroborated), or to parallel evolution of two branches which started from the same stem. At any rate, we prefer to consider the Capsian as an "outlier" of the Spanish Up. Palaeolithic (which was in turn either derived from or closely associated with the Lower Aurignacian of W. Europe) [1]. From Tunisia the Capsian has spread in certain

[1] M. C. Burkitt (1933), p. 148 has suggested a "cradle" for the Capsian "somewhere in the southern Sahara", while D. Garrod (1936 *a*), p. 169 has more recently put forward the possibility of the Capsian having been derived from the so-called Aurignacian of Kenya, and entered Little Africa "already fully developed by way of the Sahara". In this respect, however, it should be recalled that, apart from rather atypical Atirian blades and leaf-like points, no true Up. Palaeolithic has as yet been found in the S. Sahara. The Dalloni Mission (M. Dalloni, 1935, pp. 180-181) to the Tibesti area was struck by the absence of all sure signs of the Up. Palaeolithic, and particularly of the Capsian, in a region which proved to be rich in L. Palaeolithic as well as Neolithic finds and which also yielded some Levalloisian Middle Palaeolithic. Apart from some atypical (and rather doubtful) specimens (M. Dalloni, 1935, p. 143), the burin, which is one of the most typical tools of both E. African Up. Palaeolithic and Capsian, is absent from Tibesti.

parts of the W. Sahara (reaching as far as the Senegal); but on the whole the increasing aridity made it difficult for it to penetrate into the heart of that desert. Nor does it seem to have spread, to any appreciable extent, along the Mediterranean Belt in the direction of N. E. Africa or Palestine. The Up. and Final Palaeolithic cultures of these latter regions (especially N. E. Africa) had a different technique. It seems reasonable to conclude that the Capsian of Tunisia and E. Algeria became intensively localized in that area, where it persisted for a long time. The story of its closing stages and its contact with the early Neolithic (Inter-Capso-Neolithic) will be taken up in the following Section.

But the Aurignacian also spread into Palestine (and perhaps also E. Africa?). We have seen that it has had practically no effect upon Egypt; and that consequently it would not be admissible to think of the Nile as having served as a corridor for the expansion of that culture. But, if we accept the physiographic evidence of Leakey, the Kenya Colony would seem to have received a blade facies (of an Aurignacian-like appearance) as early as the close of the 1st Pluvial (*i. e.* end of Riss). The so-called L. Kenya Aurignacian is very scantily represented, but both this and the so-called Up. Keyna Aurignacian are different from the typical Aurignacian of Palestine. They resemble the L. Aurignacian (Châtelperron-like) while that of Palestine is typically of the Middle facies. It is possible that the L. Kenya Aurignacian may have been (partly?) evolved locally from an early blade group which appeared in E. Africa as early as the close of Acheulean times. But it is not impossible that both L. and Up. Kenya Aurignacian were due (in the main?) to fresh introduction from the North. We are left with the possibility, however, that such an introduction may have been effected through Palestine and Arabia. But if we accept this, we must further assume that the migration took place at an early stage (before the establishment of the Middle Aurignacian in Palestine) and that it was so quick that it left no traceable remains behind it in Arabia (S. W. Arabia). But, as already stated, the origin and exact technological contacts of the Up. Palaeolithic of E. Africa must remain, for the present, open to conjecture.

In Palestine the Aurignacian is very similar to the Middle facies of E.-C. and W. Europe. Apart from certain local differences, the similarity is so close that the possibility of a common origin of both could not be overlooked. We

have also seen that the similarity is even closer as between Palestine and Kurdistan on the one hand, and Transcaucasia and S. Russia on the other. It is therefore probable that, some time after the spreading of the Early Aurignacian, a new and more specialized facies sprang in C. and S. E. Europe (S. Russia), whence it was spread into W. Europe on the one hand, and Palestine, on the other. The movement may not have taken place simultaneously in the two directions; but it is practically certain that the relations between S. W. Asia and S. Russia continued during the later stages of the Aurignacian (as illustrated by the Palestine and Kurdistan culture).

Apart from remote and corner regions (such as South Africa, and perhaps also India?) where the Upper Palaeolithic industries have assumed an essentially local character, there remains for us to summarize conditions and culture-relations in the rest of the Saharan Belt. We have seen in the preceding Section that, already in the Mid. Palaeolithic, this region had a story somewhat different from that of the rest of the Old World. Outside influences were felt in the N. W. and in the Sahara proper in the form of the Mousterian; but this latter was soon absorbed and converted into the Atirian. The Atirian itself was destined, in its upper stages, to form the Up. Palaeolithic facies for most of the Sahara. It acquired a blade affinity, though this was probably due to an inherent process of evolution rather than to contact with the Early Capsian. It spread eastwards into Egypt and even as far as Palestine. In N. W. Africa proper it did not exert any noticeable influence upon the Capsian (except in certain stations), but it managed to spread along the W. coast of Morocco and to play an appreciable part in the development of the Early Oranian.

The story in Egypt is somewhat different from that of N. W. Africa or the Sahara. As we have seen, the Egyptian Mid. Palaeolithic was hardly affected by the expanding Mousterian. Interestingly enough, the Up. Palaeolithic of that part of Africa followed closely in the foot-steps of its autochthonous Mid. Palaeolithic. We have suggested that, at the close of Mid. Palaeolithic times, there evolved in Egypt a "Diminutive Levallois" technique, which continued, in the form of various sub-facies, in the Egyptian Up. Palaeolithic. The factor of "localization" of culture in small sub-regions was also becoming more and more pronounced in the Upper Palaeolithic phase. While, so far as we know,

the Egyptian Levallois was more or less homogeneous all over the country, the Up. Palaeolithic industries were at least of three (partly divergent) local sub-facies. In the Basin of Kom Ombo there was the type station of Sabyl which represented the culture from the Diminutive Levallois to the microlithic phase (Final Palaeolithic). Towards its close this culture group (or a degenerate form of it) was probably dispersed along the Nile Valley especially towards the South. In the region of Khargah Oasis (and opposite parts of Nile Valley), there was a second sub-facies, which was presumably ousted from Khargah by the arrival of the Atirian from the West (*via* an unknown line of migration, though perhaps through N. Libya). And finally a third culture sub-area was in N. Mid. Egypt and the borders of the Delta. It differed from the Sabylian in having a larger number of narrow blades (besides the ordinary flakes). Like it, however, it became more and more microlithic in character, though its connection with the Final Palaeolithic stage could not be established with certainty as yet. Whether this northern culture was at all in contact with Palestine is not clear; but if such contact took place, it was only towards the close of the culture, *i. e.* in the still very little known stage of the Final Palaeolithic (though the Diminutive Levallois seems also to have been scantily represented in Palestine). As a result of the comparative technological study of the material available from Egypt and the other parts of the Saharo-Arabian Belt, we are, indeed, led to the conclusion that the above mentioned "specialization" of culture which started in N. E. Africa with the Mid. Palaeolithic phase, continued and became even more intensified in the Up. Palaeolithic. Any meagre outside elements that may have found their way into this region were soon overwhelmed by the local facies. Perhaps it was that, in spite of its geographical position, this part of Africa was "sheltered" against culture-penetration from the Eurasiatic Steppe by both Palestine, on the one hand, and N. W. Africa on the other (—both of which were subjected to such penetration). It should be remembered that during the formative stage of the Egyptian Up. Palaeolithic (*i. e.* end of Mid. Palaeolithic and early Diminutive Levallois times) the climate was as yet not so arid, so that the Nile did not afford such an attractive target to migrating groups. If any such groups took refuge in Egypt at a later stage, it was too late for them to affect the already highly specialized facies of the land.

But the intensive "localization" of culture in Egypt continued right through the Final Palaeolithic, and was ultimately destined to bear its fruits in the Neolithic. We have seen that the microlithic industry of Sabyl (level III) apparently had some outward resemblances to the Final Capsian; but that its local evolution on the spot (from level II) was definitely established, at least on technological evidence. The microlithic facies of N. Egypt (Hilwan etc.), on the other hand, had a different technique from either the Final Sabylian or the Final Capsian, and it was probably also due to local development (at least in its main elements). The question, however, arises whether the earliest Neolithic cultures of the L. Nile Valley were in any way connected with, or derived from, the Final Palaeolithic facies of the region, or whether they represented entirely new cultures (whose origin may have been either in Egypt or elsewhere). It is not perhaps safe, in the present state of our knowledge, to give a definite answer to this question, as we do not know much about the possible transitional phase between Final Palaeolithic and Neolithic in Egypt. The weight of the evidence thus far available, however, points to the fact that although such microlithic facies as that of Hilwan (and also that of the Fayyoum region) persisted well into Neolithic and Post-Neolithic times, they apparently had nothing to do with, and in some cases remained largely separate from, the contemporary and more advanced cultures. But this point will be further taken up in the following Section.

Concluding Remarks on Final Palaeolithic (Microlithic) Facies.[1]

A final word must be said about the microlithic facies in general. We have already seen that in certain regions (N. W. China) pygmy implements occur as early as what may be regarded as a Mid. Palaeolithic, while in others (*e. g.*

[1] It will be noted that the Final Palaeolithic has been dealt with only sporadically in the preceding pages. This is largely due to the scarcity of material found *in situ* in different regions, and the insufficiency of data relating to past climates (fauna, etc.) of this culture phase. This is also the reason why the vague term "microlithic" (which has a *technological* rather than a *chronological* connotation) has often been substituted here to the term "Final Palaeolithic (or Mesolithic)".

Egypt[1]) some forms of them occur well within historic times. This does not mean, however, that the microlithic technique was continuous throughout the interval separating these two ages, as it is evident that these two widely separated facies had nothing to do with each other. It may be broadly stated, however, that the use of microliths tended to become more extensive during the Final Palaeolithic (or Mesolithic) stage. The world-wide distribution of these implements has even led to the suggestion of a vast dispersal of human groups, which is generally attributed to the final desiccation of climate especially to the S. of the Mediterranean. As a result of a preliminary comparative study of some of these facies, we find it wiser *not* to attribute all the microlithic industries of the Final Palaeolithic of the Old World to the same centre of dispersal. A closer technological examination of these industries (— which still awaits attention—) will almost certainly show that regional differences among these groups of "microliths" are far more pronounced than has hitherto been assumed. Furthermore, if we take their distribution as a whole, we find that the regions, which have thus far yielded them, seem to fall into two groups: 1) regions where the microliths first appear in the Up. Palaeolithic and become predominant in the Final Palaeolithic (*e. g.* N. Africa generally—including Egypt—and E.—and presumably also S.—Africa); 2) and others where they appear only as a Final Palaeolithic facies (*e. g.* W. Europe—and perhaps also E. Europe and India). On this basis, it may be assumed, with some reason, that pygmy facies of the Final Palaeolithic may have started simultaneously, in more than one centre from among the regions where they made an early appearance, and may have spread into other regions where they were separate from the Up. Palaeolithic. It would be well to emphasize, however, that even in regions of the first category microlithic facies seem to have lingered well after the passing of the Final Palaeolithic proper. Their survival into the Neolithic (and later), especially in countries within the Saharo-Arabian Belt, will be further elaborated in the following Section.

[1] Also in other countries, such as S. W. Arabia, we have definite proofs of the use of a microlithic facies as late as the beginnings of the Christian era; see S. A. Huzayyin (1936 *a*), pp. 140-141 and (1937 *a*), p. 513.

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Addendum : On Human Skeletal Remains from the Up. Palaeolithic.

It may be noted that in the argument above, we did not deal with the evidence of human skeletal remains. Two reasons account for this : in the first place that the material available is still so fragmentary that any general correlations based upon it would be rather misleading; and in the second, that the writer felt far from competent to deal with such material in any way that would contribute to the elucidation of the point under discussion. It may be stated broadly, however, that whenever human remains have been found with any Up. Palaeolithic facies, they have proved to belong to *Homo sapiens*. In Europe a number of types of this species occur; of which the most conspicuous are the Combe Capelle, Cro-Magnon and Grimaldi racial types [1]. The last has marked negroid affinity. In N. W. Africa, a racial type occurs (especially with the Oranian), which is different from both the Cro-Magnon and the Grimaldi [2]. In Palestine, only few remains (including skull fragments) have turned up from the Aurignacian levels as yet; but these may safely be attributed to *H. sapiens* [3]. In Egypt, the only bones that have come to light have been found in the Sabylian formations; and interestingly enough they are nearer the Pre-Dynastic Egyptians than any other prehistoric racial type [4]. In E. Africa, human remains are more abundant and they belong to a type more or less similar to the present Masai people, and in any case, quite different from modern negro types [5]. And finally in the S. Sahara (Asselar, in Adrar region,

[1] For good comprehensive accounts see M. Boule (1923), pp. 264-293; and H. Peake and H. J. Fleure (1927 *a*), pp. 59-77.

[2] See M. Boule and H. Vallois (1932), pp. 57-59; also reference in E. G. Gobert and R. Vaufrey (1932 *a*), pp. 456-457.

[3] It is even thought that these remains may have belonged to a type that was not much different from the Natufians. These latter were, in some respects similar to the Pre-Dynastic Egyptians. See D. A. E. Garrod (1934 *b*), pp. 142 and 138.

[4] See K. S. Sandford (1934), p. 86.

[5] See L. S. B. Leakey (1931), pp. 108-109; also reference in M. Boule and H. Vallois (1932), pp. 60-65.

to the N. of the Niger Bend), a human skeleton has been found, in a rather doubtful position; and Boule thinks it has some Bushman affinities [1]. It is clear from this rapid account that racial types (of *Homo sapiens*) in the Up. Palaeolithic were well differentiated in divergent groups [2]. This makes it all the more difficult to trace their origins and their dispersals. Of the authorities engaged on the subject, only M. Boule has been bold enough to suggest some connection between the Negroid elements of Europe and Africa (Bushmen) [3]. More recently, he has gone as far as to contend that the discovery of the Asselar man provides the necessary link between the two [4]. It should be noted, however, that the facts that the Asselar man is rather doubtful (its age is judged largely by its mineral condition), and that the racial types thus far discovered in N. W. Africa are different from both Grimaldi and Asselar, make it exceedingly difficult to accept Boule's conclusions. It seems that, in the present state of our knowledge, it is safer to refrain from such speculations on the spreading of human groups and cultures, as may touch racial affinities. Admittedly, the archaeological data may not be enough in themselves, but they provide the best picture of the prehistoric drama of men in the present circumstances.

[1] See M. Boule (1931), pp. 255-257; and M. Boule and H. Vallois (1932), pp. 10-37 and 77-81.

[2] Even in Europe, the tendency is now to regard that there were more and more divergent types. See H. Peake and H. J. Fleure (1927 *a*), p. 70.

[3] M. Boule (1923), pp. 311-312.

[4] M. Boule and H. Vallois (1932), pp. 77-81.

PART II (*Continued*).

SECTION III.[1]

THE NEOLITHIC AND POST-NEOLITHIC CULTURE-STAGES.

A SYNOPSIS OF THE CULTURE COMPLEXES AND CONTACTS OF EGYPT IN LATE PREHISTORIC AND PROTOHISTORIC TIMES, WITH SPECIAL REFERENCE TO FLINT INDUSTRIES.

INTRODUCTORY :

The Problem of Culture Contacts. Value of a Comparative Study of Flint Artifacts.

The present final Section is not intended to include an exhaustive study of the final stages of prehistoric times. Such a study would require a whole special work to itself. Furthermore, the fact that the Neolithic stage was not even approximately synchronous in different parts of the Old World renders a synthetic treatment, of the type we have so far pursued, entirely impracticable. For these, and other reasons, it is proposed to limit the present Section to a brief comparative study of the culture complexes of Egypt and its neighbouring regions during late prehistoric and protohistoric times. It is hoped that this may help to assess the local and outside factors that may have been involved—directly or indirectly—in the evolution of culture in N. E. Africa during this phase. Such a study would finally lead to the questions : Is Egyptian civilization as we know it at the dawn of history autocthonous? or is it of outside extraction? And if it were of local origin, when did it get into

[1] The present writer has already published a separate monograph (S. A. Huzayyin 1939) on the Beginnings of Egyptian Civilization and incorporating (together with other material) most of the main topics dealt with in present Section. Some of the conclusions arrived at there, however, have had to be amplified, or partly modified, in the light of still more recent data.

contact with the outside world, and to what extent was it affected by it? This line of investigation has been followed by previous writers (*e.g.* H. Frankfort, 1924, A. Scharff, 1927, etc.), but in practically all cases the main attention was directed to pottery and a number of other *tradable* articles. This method of approach has certainly been useful in bringing up a number of valuable points especially in matters connected with the study of commercial and cultural relations. It was not, however, entirely immune from criticism. Pottery is a *tradable* article and, moreover, the technique or pattern of some of its wares can sometimes be copied. Thus although its study may be very useful for dating and correlating cultures, it may actually be somewhat misleading in tracing *local* facies of culture. The case is even more so with certain other classes of more easily tradable articles (beads, ornaments, etc.) which, under certain circumstances (as in a grave group for example), may be found in such proportions as to overwhelm and even mask other articles of *local* manufacture. On the other hand, a comparative study of flint implements (or rather "groups of flint implements") may be less misleading. We have definite proofs from many of the settlements excavated in Egypt that the flint industry was largely worked locally. Large numbers of discarded chips, unfinished tools, broken and reworked specimens, etc., are usually found either in the settlement or at some near-by chipping site. Even in cases when imported types were copied, the actual execution and final finish of the tool were largely governed both by the skill of the copier and the nature of the material available. In other words, the technological study of the flint industry in the various settlements and cemetery groups may be more reliable in tracing local differences and specializations. Needless to add that in attempting to obtain a sufficiently balanced picture of the culture complex of a region like the Lower Nile Valley, it is as necessary to know the elements of local differentiation as those of general and wide correlation. Groups of flint tools may therefore offer a useful check on data from pottery, beads, ornaments, etc.; and the check is all the more welcome when we come to study culture sequence and correlations in widely separated areas. It is for this reason that we thought a comparative study of the flint industries of Egypt and its neighbouring regions may be a helpful complementary to what we already know from studies on other classes of remains.

THE THREE MAIN APPROACHES OF EGYPT. CULTURE CONTACTS IN NEOLITHIC AND POST-NEOLITHIC TIMES.

Speaking generally, we may state that there are three main approaches of Egypt in late prehistoric times—namely the W., the S. and the N.E. The W. approach includes most of the Sahara and N. W. Africa, while the S. one extends into Nubia and the Sudan Plains, touching upon Erythrea and E. Africa. The N. E. approach, on the other hand, can be limited (for working purposes in the present treatment) to the Syrian-Palestinian horn of the Fertile Crescent. The Mesopotamian-Iranian side, though very important in the protohistoric culture-sequence of the Near East, has so far yielded practically no signs of contact with the earliest (purely Neolithic and very early Chalcolithic) cultures of Egypt. It is proposed, in the present study, to start with these approaches of Egypt, and to follow up with an epitome of the culture complexes and orientations of Egypt in Neolithic and later times.

The W. Approach of Egypt (Sahara and N. W. Africa). The Vexed Problem of Rock-Drawings and Paintings.

We may start with the W. approach (*i. e.* the Sahara and N. W. Africa). A word must first be said about the much vexed problem of the rock drawings and paintings which have been found in N. W. Africa, in the Interior of the Sahara and its S. borders, in the 'Uweinat Massif and in Nubia and Uppermost Egypt [1]. They appear to link up with both the E. Spanish group, on the one hand, and the E. Abyssinian and S. African ones, on the other [2]. Some

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[1] On N. W. Africa and the Sahara see especially such works as G. Flamand (1921), L. Frobenius and H. Obermaier (1923-25); H. Breuil (1931), pp. 97-112; Obermaier (1930), pp. 267-272 and R. Vaufrey (1939 *a*). On the Uweinat Massif see Breuil (1928), pp. 4-15 and H. Winkler (1939) pp. 307-312. On Nubia see G. Schweinfurth (1912) and Sandford and Arkell (1933), pp. 63-71; also more particularly J. Dunbar (1934), pp. 139-167.

[2] H. Breuil (1931), p. 97.

authorities [1] place their earliest representatives in the Up. Palaeolithic, while others regard them as late Neolithic [2]. Unfortunately the question cannot be settled definitely, as the engravings are never found in undoubted association with stone implements or other remains that may help to date them. H. Breuil has recently ventured, however, to divide these drawings (apart from the purely historic ones) into three main series [3] : *a*) the oldest and least abundant, representing «*le grand bubale antique*» (*Bubalus antiquus*), the elephant, etc. It may have been Pre-Neolithic or perhaps late Upper Palaeolithic, in date; *b*) the middle series with abundant well executed drawings of naturalistic or semi-naturalistic style. The fauna includes rather rare *grand bubale et bœuf,* together with elephants, rhinoceros, lion, panther, giraffes, antelopes, African ram (*Ovis longipes?*), ostriches, etc. There are signs of either domestication or semi-domestication (*apprivoisement*). This group may be dated either to some transitional phase between the Up. Palaeolithic and the Neolithic or to the latter; *c*) the third and most recent series is rather conventionalized with bodies of animals represented by a rectangular shape. It includes *bœufs*, elephants, lions, giraffes, goats, sheep, ostriches, etc. It is equated roughly with the Proto-Dynastic phase of Egypt and the Neolithic of E. Spain. Of course this method of dating, however helpful it may be, cannot be entirely safe, and is used only as an approximation. It appears, on the other hand, that further precision may be reached by referring to the evidence of past climates. It is clear that the wide distribution of this culture (which is, to a certain extent, homogeneous, though not strictly belonging to one sub-phase) and the variety of animal groups it represents can correspond only to a phase of relative increase in rainfall. According to recent evidence from the Sahara and N. W. Africa the Up. and Final Palaeolithic represented a phase of increasing aridity, while the Early Neolithic corresponded to an increase in precipitation over most of the Sahara [1].The latter stage was also accompanied by a renewal in the faunal migrations between the Sudan Belt and N. W. Africa. In this respect, it is interesting to note that the *Bubalus* (or *Buffelus antiquus?*), which appears in the earliest series of Breuil, is represented among the faunal forms of N. W. Africa only from deposits belonging to the Mousterian (and earlier phases) on the one hand, and the Neolithic on the other [2]. It "skips" the Up. Palaeolithic proper. Also the only ascertained remains of the African elephant occur, for the first time, in the Neolithic, while other species of this animal become extinct (or emigrate) by the end of the Mid. Palaeolithic [3]. On this evidence, therefore, it would appear improbable that the rock drawings and paintings of the Sahara and N. Africa could be placed either in the Up. or in the Final Palaeolithic. Interesting physiographic evidence has also turned up more recently from Nubia [4]. The earliest series of drawings there stands at 10-12 m. above the present river; and consequently, they could not have been executed before the phase of "degradation" which took place after the Sabylian proper (or from Middle Sabylian times onwards) [5]. Their earliest possible date is the late-Mid. or rather the Up. Sabylian, though in all probability, they belonged to the same date as the early drawings of the Sahara, *i. e.* the Neolithic wet phase

[1] *e. g.* H. Kühn (1928), p. 79.

[2] *e. g.* G. Flamand (1921) (referred to in A. Bernard, 1921, pp. 19-21 and S. Gsell, 1913, p. 54). On the general question of dating Saharan rock drawings see also R. Vaufrey (1936), pp. 624-638, and a more recent pub. by same author (1939 *a*) (in the *Arch. de l'Inst. de Paléont. humaine,* Paris) which we did not see.

[3] H. Breuil (1931), pp. 101-107. The division is based on the technique and *état physique* of the drawings, as well as on the animal groups they represent.

[1] See particularly works by J. Bourcart (1933), pp. 825-826, and A. S. Romer (1928), pp. 131-132. We find reason to believe that Saharan latitudes in general (including Egypt) had a "Neolithic" wet phase (using the term "Neolithic" in a very wide sense). *Vide supra,* Part I.

[2] A. S. Romer (1928), p. 162.

[3] A. S. Romer (1928), p. 161.

[4] K. S. Sandford and W. J. Arkell (1933), pp. 70-71.

[5] It is not clear whether what Sandford and Arkell (*ibid.*) regard as the Mid. Sabylian (representing the phase during which degradation started) was really a typical Sabylian culture or rather a degenerate form of it. During late Mid. Palaeolithic and early Sabylian times there was a phase of "aggradation" in Nubia, during which the water mark reached 30 m. above the present flood plain at Wadi Halfa. During that early phase, the level at which the drawings were made was well under water. After this "aggradation" there came a new phase of "degradation" (from Mid. Sabylian times onwards) during which the water-mark was gradually lowered beneath the level at which the drawings were made. The pictures (which are not water-worn) must therefore be later than both processes of "aggradation" and "degradation". On the physiographic cycles of the L. Nile Valley *vide supra* Appendix to Part I.

(equivalent of the Climatic Optimum in N. W. Europe, *i. e.* from about the middle of the 6th mill. B. C. onwards) [1]. If this be so, both culture groups (in Nubia and in the Sahara) may perhaps be attributed to one and the same movement of migration of people with similar artistic traditions. Whether this movement started in the South (on the E. border of Abyssinia and Somaliland?) or in the North (E. Spain and N. W. Africa) is a matter that awaits further elucidation, though the first alternative is the more probable one [2]. While the typical and the Final Capsian are exceedingly poor in artistic expressions, the microlithic (Final Palaeolithic or later) industries of S. E. Ethiopia have yielded rock drawings of high interest [3]. The similarities between the Sahara, on the one hand, and S. Africa on the other, render it likely that the two regions may have been affected by a culture-drift which started in some intermediate area between the two. This point, however, will be further referred to a little later [4].

The Neolithic of N. W. Africa and the Sahara.

The Neolithic phase of N. W. Africa and the Sahara is still very little known [5]. Starting with the former region we find that the earliest traces of the Neolithic are represented by the so-called Inter-Capso-Neolithic («*Intergétulonéolithique*» of Gobert), leading into the *Néol. de tradition capsienne* [6]. These include a mixture of the Capsian and the Neolithic; the latter being simply superimposed upon the former. The lithic industry is made up of abundant microliths of geometrical forms, narrow *lames à dos rabattu*, «*limaces*» (or «*lamelles à deux*

[1] On this so-called "Neolithic" wet phase in Saharan latitudes and its equivalents elsewhere see S. A. Huzayyin (1936), pp. 19-22 and 88; also *vide supra*, Part I.

[2] It is not impossible, however, that although the main migration was from the South, E. Spain may have exerted some influence. Little is known about the possibility of certain African elements having been introduced into Spain in the Early Neolithic phase. On other possible, and perhaps more recent, drifts reaching Egypt, see H. Winkler (1937), (1938) and (1939), pp. 308-309.

[3] See H. Breuil (1934), pp. 473-483.

[4] There are also certain similarities between some of the Saharan drawings and the historic ones of Egypt. It is almost certain that these similarities represented a culture-diffusion from Egypt westwards; but they need not engage us here.

[5] Forthcoming pub. by Vaufrey *La Préhist. du N. de l'Afrique, Arch. Inst. Paléont. hum.*, Paris,

[6] Gobert (1914), pp. 19-22 and (1912), pp. 152-168; also Vaufrey (1933), pp. 478-480.

tranchants abattus»), blades with lateral «*encoches*», small (semi-round?) sickles (or denticulated end-scrapers?), small arrow-heads of typical Saharan forms (lozenge-shaped, fork-based or tanged) and rare laurel-leaf points of rather crude workmanship. Polished axes and pottery also occur. It is clear from this mixture that we are dealing with a blend of two culture-phases. It hardly needs emphasis, however, that the Neolithic elements can in no way be regarded as having evolved from the Final Capsian. All indications go to the effect that these advanced elements represented a new or "introduced" facies which was mixed locally with surviving Capsian industries.

Other traces of the Neolithic proper are rather scanty. There are certain Megalithic structures (Dolmens), which are regarded by some workers as representing proto-types for the Egyptian Mastabas [1]. Apart from the fact, however, that such an assumption is not easily acceptable on technical grounds [2], the dates of these N. African Dolmens are, in all probability, later than the earliest Egyptian Dynasties. The evidence thus far available from the N. borders and the interior of the Sahara seems to be definitely in favour of a comparatively late date for the Neolithic cultures there [3]. Several surface stations in this Saharan zone have yielded Capso-Neolithic cultures of a somewhat degenerate character. The Neolithic is usually characterized in this region by an abundance of small arrow-heads of many types, but usually different from those of the Egyptian Neolithic [4]. The Oasis of Ouargla and some other parts of the N. Sahara have yielded interesting flint implements which throw useful light on the question of contact with Egypt [5]. These

[1] E. Baumgärtel (1926), pp. 27-28 and 35.

[2] See discussion of Baumgärtel's views in A. Scharff (1927), pp. 45-46.

[3] For a good account about these cultures see H. Breuil (1931), pp. 86-93 and accompanying figures. Of course, we are not concerned here with the "retarded" and mixed cultures of the Neolithic which continue in parts of the Sahara until Roman times.

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[5] For the material from Ouargla see coll. of the Manchester University Mus., specimens registered as W. Boyd Dawkins Collection. Also coll. of the Inst. de Paléont. hum. (Paris), specimens regist. as from Ouargla.

(equivalent of the Climatic Optimum in N. W. Europe, *i. e.* from about the middle of the 6th mill. B. C. onwards) [1]. If this be so, both culture groups (in Nubia and in the Sahara) may perhaps be attributed to one and the same movement of migration of people with similar artistic traditions. Whether this movement started in the South (on the E. border of Abyssinia and Somaliland?) or in the North (E. Spain and N. W. Africa) is a matter that awaits further elucidation, though the first alternative is the more probable one [2]. While the typical and the Final Capsian are exceedingly poor in artistic expressions, the microlithic (Final Palaeolithic or later) industries of S. E. Ethiopia have yielded rock drawings of high interest [3]. The similarities between the Sahara, on the one hand, and S. Africa on the other, render it likely that the two regions may have been affected by a culture-drift which started in some intermediate area between the two. This point, however, will be further referred to a little later [4].

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include laurel-leaves and javelin points, which are finely worked on both faces. There are also knives made of tabular flint with marginal flaking usually on one edge and on the tip only (leaving the other edge and the base-end intact) [1]. Another interesting implement (usually made of chalcedony), which occurs very sporadically is the so-called «*flèche pistiliforme*» which has been recovered from Ouargla and the region of Tabelbalat [2]. The similarities between these industries and those of the Chalcolitic and protohistoric phases of Egypt must be left for consideration at a later stage.

The S. border of the Sahara is again less known than the North. On the whole, however, we find that here too, the Final Palaeolithic cultures seem to have survived, though the mixture with the Neolithic may appear somewhat less conspicuous. A surface station of special importance has been found in the region of Ounan (N. of Tumboktu), and H. Breuil distinguishes there a blade culture which he calls Ounanian [3]. As may be seen from Pl. XVI the industry is made chiefly of long blades and blade-points with a median ridge and a narrow tang or shank made by vertical retouching. It also includes prismatic rods with a triangular section. "Typologically" this industry may perhaps appear as having a retarded Palaeolithic affinity (*vide supra*, pp. 246-247): but it can in no way be compared with the Capsian or any other typical Upper Palaeolithic culture [4]. As the region in which it has been found is particularly dry at present, it must have coïncided with a phase of increased precipitation. If the conclusions arrived at by most workers on Saharan Climates [5]

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[1] For a specimen of this form from the interior of the Sahara (Temassenin) see Pitt-Rivers Mus. (Oxford), Fromholtz Coll. 1914, No. 343 (also our Pl. XIV, Nos. 14-15). As we shall see later on, this implement is typical of the B culture (late Neolithic) of Fayyoum; and it also occurs in Siwah (compare our Pl. XIV, Nos. 12-13).

[2] H. Breuil thinks (1931, p. 90), that this very special type of arrow-head which is evidently foreign in the N. Sahara, can only have come from Egypt where it occurs in the Naqadah-Abydos region (Proto-Dynastic or Early Dynastic; see W. M. Flinders Petrie 1915, p. 124 and Figs. 203-205) and also at Ma'adi (late Pre-Dynastic, *vide infra*). For this type see our Pl. XIV, Nos. 28-30 (from Egypt) and 31-32 (from Ouargla).

[3] See H. Breuil (1931), p. 78 (where he considers it as having a retarded—Up. or Final ?—Palaeol. appearance). Also coll. of the Trocadéro Mus. (now called *Musée de l'Homme,* Paris), specimens regist. 33.19. 535-662. (Compare also our Pl. XVI, Nos. 1-6.)

[4] The tang or shank technique in Ounanian is quite different from it in Atirian.

[5] See more particularly works of J. Bourcart (1933) and A. S. Romer (1928).

be accepted, this culture cannot be placed in the Up. Palaeolithic phase which was especially dry over the whole of the Sahara and its fringes. Furthermore, we shall see a little later that the Ounanian industry is not entirely without parallel in Egypt and Palestine. "Ounanian" blade-points and prisms occur in Khargah Oasis and also as far N. as the Fayyoum, where they cannot be regarded as Up. or even as Final Palaeolithic (*vide infra;* also compare Pl. XVI). Similar blade-points also occur in the Early Bronze of Palestine [1]. We therefore prefer to place the Ounanian of the S. Sahara in the wet phase, which coïncided with the Neolithic (and later) of Egypt [2]. To the same phase belong, in all probability the fine microlithic "bifacial" lunates and their accompanying forms of the Burg al-Ruz, to the N. of Ounan [3]. Another industry from a neighbouring region (the Adrar Ahnet, to the E. of Ounan) must have also been accompanied by wetter conditions than to-day [4]. It is found in *kjokkenmöddinger* with abundant fish remains. The industry is made up of a multitude of blades, short tanged points, microlithic end-scrapers (thumb scrapers), backed and "bifacial" lunates, fine javelin-points and arrow-heads of various descriptions (usually small, with or without tang, sometimes of a triangular shape or with slightly hollow base) [5]. Crude pottery has also been found. This industry is evidently a *mixed* one, having both Final Palaeolithic and Neolithic affinities. In this respect it may compare (?) with a degenerate and mixed facies which has been found at Wadi Halfa (*vide supra,* p. 254) [6]. But it also links up with a *so-called* Neolithic culture discovered in the Nigerian Sahara [7]. The chronological place of this latter is not known, though in all probability it is not much earlier than the so-called "Sudanese" Neolithic,

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[1] *Vide infra;* also Pl. XVII.

[2] For evidences of this wet phase generally, *vide supra*, discussion at various places in Part I of present work. Also for indications of its existence in Egypt see G. Caton-Thompson and E. W. Gardner (1929), pp. 34-36 and 39, and (1932 *a*), pp. 371-372.

[3] On this see Coll. of Trocadéro Mus. (now called *Musée de l'Homme*, Paris), specimens regist. 33.19.1153-1157, etc.

[4] On this see Th. Monod (1931), pp. 253-284; also his work (1932).

[5] See Planches A-D in Th. Monod (1931).

[6] For this see Coll. of Manchester University Mus., specimens regist. A. Archer O. 2017.

[7] See H. Kelley (1934), pp. 135-143 and Pls. VIII-X.

which may be quite historic [1]. It is rather of a mixed nature as it includes, together with flat triangular and hollow-base arrow-heads (similar to Dongola specimens of the E. Sudan) and ground axes of Sudanese style, typical Saharan arrow-heads of the tanged and fork-based types. The mixed nature of this industry suggests that it is of a comparatively late date (and certainly later —perhaps very much later— than the typical Neolithic of Egypt).

Summary of Evidence from W. Approach.

To summarize the evidence from the Sahara and its N. and S. borders, it may be roughly stated that there are areas with mixed Final Palaeolithic and Neolithic facies and others with somewhat purer Neolithic cultures. Taken as a whole, the mixture is usually more on the outside fringes (N. W. and S.), while the interior is chiefly characterized by a typical "Saharan" culture whose rich variety of small arrow-heads is a distinctive feature. All these industries (followed in the S. by the much later and so-called Sudanese Neolithic) appear to have prospered at one moment or other during the last wet phase, which may be called, for convenience, as "Neolithic" (using the word in its widest sense). In all probability, this phase was marked by wide movements of human groups with high artistic abilities. We prefer, for the moment, to think that there have been more than one drift of culture, though it is not possible to speak with certainty about their origin or lines of migration. It must be admitted, at the same time, that local elements, surviving from the Up. and Final Palaeolithic, also played their part in the culture-development of this phase. This is testified by the fact that the mixed industries (*e. g.* Inter-

[1] It is interesting to note that this industry of the Nigerian Sahara includes arrow-heads and microliths (H. Kelley, 1934, Pl. IX-X) very similar to specimens found in tumuli dating approximately from the 9th and 8th centuries B. C. in the Dongola region of the E. Sudan; compare coll. of the Archaeological Museum, Gordon College, Khartoum, regist. Nos. 1576-1579; and see also *Man*, Vol. XXVI, No. 85. Kelley (1934, p. 143) suggests certain typological similarities between some of the arrow-heads of the Nigerian Sahara and those of Badari and the Early Fayyoum in Egypt. The present writer, who has had the chance of examining the Nigerian specimens finds, however, that they are much smaller and more slender in size (than those of Badari and the Early Fayyoum), and appear to represent a somewhat degenerate technique. The similarities with the historic industry of Dongola are, on the other hand, much closer.

Capso-Neolithic) occur, for the main part, in regions where the Final Palaeolithic was deeply rooted (such as the N. W. and parts of Tabelbalat region). Furthermore, we hardly need to point out that the typical Saharan arrow-head industries were for the most part autochthonous. On the other hand, we have seen that certain parts of the Sahara (such as Ouargla, Tabelbalat, etc.), have yielded evidence of unmistakable connections with Post-Neolithic, Proto-Dynastic and Early Dyn. Egypt; and to these further references will be made at a later stage. In the S. of the Sahara, it seems that, right from its beginning, the so-called "Neolithic" wet phase was accompanied both by an industry (the Ounanian) whose technique may appear as having a retarded Palaeolithic affinity, but which is much later in date, and by a group of other facies (in *Kjokkenmöddinger*) with even more mixed nature. It is probable that this S. border was also in connection with Egypt (and, later on, Dongola), though this point still needs elucidation. At any rate, this question, together with the possibility of a culture diffusion along the Sudan Belt (in one direction of the other), will be taken up after we have examined the Egyptian side.

The S. Approach of Egypt. Contacts with Nubia, Erythrea (Erythraea) and Beyond.

Little can be said about the S. approach of Egypt which is still imperfectly known. The so-called Neolithic cultures recently discovered in Kenya [1] may have, in fact, corresponded to historic cultures in the North, as they coïncided with the Nakuran wet phase—a later oscillation of the last wet phase of that region [2]. Of more interest, from our present point of view, are the microlithic facies of S. E. Abyssinia [3]. These appear to have been accompanied

[1] On the Gumban A and B and the Njoroan cultures see L. S. B. Leakey (1931), pp. 198-231.

[2] In Part I of the present work we have correlated the Makalian wet phase of E. Africa with the so-called "Neolithic" wet phase of Saharan latitudes (mid. 6th to mid. 3rd mill. B. C.). This latter phase, however, appears to have had a late oscillation (in 1st mill. B. C. to early centuries A. D.), which may be equated with the Nakuran of E. Africa; see also S. A. Huzayyin (1936), pp. 21 and 88. Recent evidence brought back by an expedition sent by the Cairo University to S. Arabia throws grave doubts on the early dates attributed to the so-called Neolithic cultures of E. Africa (part of which may ultimately prove to be of Christian date); see S. A. Huzayyin (1936 *a*), pp. 140-141 and (1937 *a*), p. 514.

[3] On these see H. Breuil (1934), pp. 473-483.

by rock drawings of similar nature and technique to those of 'Uweinat and N. Africa. Some of the animals pictured (including even the «*grand buffle africain*»!) appear to have been domesticated (or held in captivity?), and H. Breuil draws the conclusion that we are probably dealing with a region which played an important (though perhaps independent) part in the story of domestication [1]. Unfortunately, it is not possible to give these drawings and cultures any definite date, and nothing can be said with certainty about their position as a probable link between similar cultures in South Africa on the one hand, and the Sahara on the other. Perhaps their chronological and cultural status will be better elucidated when we get to know more about the important region of N. Erythrea and the Sudan Plain. In Nubia proper an important rock-drawing group has long been known (*vide* a little *supra*). In spite of the apparent concentration of this culture (or a facies of it) in the river valley (thus acquiring a local character) it had marked outside connections, especially with the Early 'Uweinat group. It is not clear, however, whether this culture was in any way connected with a degenerate Sabylian-like industry found at Wadi Halfa (*vide supra*); an industry which, as a facies, shows no connection with the microlithic (surviving Final Palaeolithic?) of S. E. Ethiopia. As the physiographic evidence (to which reference has already been made) is definitely in support of the assumption that these Nubian drawings were later (perhaps much later) than the typical (Mid.) Sabylian, it is probable that they belonged to a drift later (perhaps much later) than (and different from) that which brought the Sabylian and associated facies (into Nubia) from the North. Other Nubian cultures of more certain date and belonging to the Chalcolithic phase (and later) indicate connections with Egypt. These are the so-called Kubbanian, and the A, B and C Groups of Nubia [2]. The first of these (the Kubbanian) is roughly equated with the Pre-Dynastic phase of Egypt, while the latter three Groups (A, B and C) are regarded as contemporary with the Old and Middle Kingdoms [3]. The beginnings of the Nubian cultures are thought by certain authorities to have been connected with a southward migration of some Badarian folk after the destruction (or dispersal) of this latter culture (perhaps by other cultures developing locally or advancing from further North?) in Up. Egypt proper [1]. Whatever may have occured it is practically certain that during the late prehistoric and protohistoric phases of Egypt, Nubia formed a southern "recess" or "retreat" which received, and preserved for a long time, culture elements advancing (or rather being pushed) from further North [2]. The same role was largely assumed by Nubia from that time onwards.

[1] H. Breuil (1934), pp. 481-482.

[2] On these cultures of Nubia see works of H. Junker (1919) and (1920) : G. A. Reisner (1910); C. M. Firth (1912), (1915) and (1927) and E. P. Weigall (1907). Also summary in A. Scharff (1931) pp. 28-29.

[3] On their chronological place see O. Menghin (1932), Table on p. 27.

The story of the southern borders of Egypt is therefore rather a complicated one. In late Up. and Final Palaeolithic times, Nubia seems to have constituted a culture sub-area of the Sabylian, though it may also have had some connections with S. Sahara. Later on it received, at a certain unknown date, a branch of the widely-spread rock-drawing culture group, whose origin is still a mystery. It should be noted, at any rate, that no trace of the true Neolithic has thus far been found in Nubia. The cultures that we know are directly derivable from (or could be connected with) the Egyptian Post-Neolithic and early historic civilizations. During the whole of these latter phases the culture diffusion has largely come from the North.

The N. E. Approach of Egypt. Contacts with the Fertile Crescent and the Borders of Iran.

The third and last approach for us to consider is the North-East. On this side we have the Iranian Plateau (and its Mesopotamian borders), on the one hand, and the horn of Syria-Palestine, on the other. Though very important in the late prehistoric and protohistoric culture-sequence of the Near East,

[1] See H. Junker (1933), pp. 10 and 19; also G. Brunton (1928), pp. 21 and 38-42, where he implicitly attributes the pan-grave culture of Nubia (at least partly) to some rather degenerate Badarian culture.

[2] It was probably during these phases that Nubia had served as a corridor for cultural penetration from Egypt into the Sudan and Negro Africa and perhaps also as far as S. Africa. On elements of this penetration see C. G. Seligman (1932), pp. 457-462 and (1934), pp. 3 and 58-60; also H. Frankfort (1932 *a*), pp. 445-453 and H. Breuil (1931), pp. 80-81 and (1937*b*), pp. 158-159.

the former area has so far yielded practically no signs of contact with the earliest (purely Neolithic and very early Chalcolithic) cultures of Egypt. During this phase, the Iranian Plateau and its borders constituted a culture area of their own [1]. The rather exaggerated dates first suggested by L. Woolley (1928) for the Sumerian and Ante-Diluvian (*i. e.* Pre-Flood) cultures of L. Mesopotamia, are now being revised in the light of more recent excavations [2]. It is also interesting to note that, as we know them, the earliest cultures of Mesopotamia and Iran are not of a pure Neolithic form [3]. The properties of copper were known as early as Susa I [4]. It is probable that copper was used in this region at an earlier date than in Egypt, but the evidence of the pottery points also to the Iranian cultures (as we know them) as having been of a more evolved type than the earliest (purely Neolithic) cultures of Egypt. At any rate, although the question of absolute chronology between these two main culture-areas of the Near East (L. Nile Valley and Mesopotamia-Iran) cannot be settled as yet, there can be little doubt that the earliest traces of contact between them can be carried only to the Second, *i. e.* Gerzean (and very slightly to the First) Pre-Dynastic phase of Egypt (though these relations became well marked only in late Pre-Dynastic and Proto-Dynastic times) [5]. For all these reasons, we prefer in dealing with the beginnings of Neolithic and Early Chalcolithic civilizations in Egypt to limit our treatment of the N. E. approach to the Syrian-Palestinian horn of the Fertile Crescent [6].

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[1] For summary accounts on Sumerian and Highland elements in the Mesopotamian protohistoric cultures see H. Frankfort 1932 and 1934; also V. G. Childe 1934, pp. 130-203.

[2] See especially H. Frankfort 1932 and 1934; also *Nature*, No. 3412, vol. 135, 1935, pp. 478-479.

[3] Although so-called Neolithic remains (*i. e.* with no copper) have been found at Kish and in certain places on the Iranian Plateau (see reference in H. Peake, 1930, pp. 102 and 109), the data thus for avaibable from these regions are still scanty, and we can hardly speak of a Neolithic culture in the full sense. It should be pointed out, however, that the true Neolithic of this part of the Near East may still be revealed by future discoveries.

[4] See J. de Morgan (1909), p. 203, footnote 1; also V. G. Childe (1929), pp. 129 and 132-133 and (1934), pp. 233-234.

[5] On these contacts in general see H. Frankfort, 1924, pp. 118 f.; also references in G. Childe (1934), pp. 106, 116 and 120-127. For reference to earliest sign of contact in First Pre-Dynastic (or Amratian) times see G. Brunton (1937), pp. 83-84.

[6] The Mesopotamian side will be referred to only incidentally in the protohistoric phase.

The possibility has been put forward, of the art of agriculture (at least of Emmer) having first started in this region of Syria-Palestine, hence it spread into N.E. Africa and other regions [1]. The problem of the beginnings of agriculture is still an open one, and the evidence bearing upon it remains for the most part of an indirect nature. It would perhaps throw more light on the question of early cultural relations between Syria-Palestine on the one hand, and N. E. Africa on the other, to review briefly the archaeological data available from the former region before we proceed to Egypt proper.

The Natufian of Palestine and its Cognate facies at Hilwan.

Thanks chiefly to work carried out by D. A. E. Garrod, a mass of information has been accumulating in recent years on the newly discovered Final Palaeolithic industry of the Natufian [2]. This industry is characterized by a highly specialized microlithic technique, with small "*lames à dos rabattu*", triangles, crescents, micro-burins, etc. It also includes sickle blades with glossy edge, showing that they were used in cutting silica-bearing straw (like that of wheat). This may of course be taken to indicate that the people knew some form or other of primitive cultivation [3]. It is interesting to note, however, that pottery was entirely unknown, while animal remains show no signs of domestication [4]. It is not known as yet, whether this industry was autochthonous in Palestine; for the Up. Palaeolithic shows very little indications of developing into a microlithic facies. It may be recalled, however, that the Natufian presents certain resemblances to the Early microlithic industry of Hilwan (Helwan, S. of Cairo). Of special interest is the existence in both industries (and

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[1] H. J. E. Peake (1928), pp. 54-55 and (1931), pp. 102-107.

[2] See D. A. E. Garrod (1931), pp. 9-10 (1932 *a*), pp. 6-9 (1934), pp. 107-108 (1934 *b*), pp. 135-138 and more particularly (1932 *b*), pp. 257-269 and accompanying figures; also more complete final publication by Misses D. Garrod and D. A. E. Bate on Palestinian caves (1937).

[3] The fact that some of the lunates were found in haft indicates that this type of implement (which is exceptionally abundant) was probably used as a sickle. This makes it all the more probable that the Natufians depended for a large part of their supplies upon grain, either from cultivated corns or just from natural fields which they guarded and reaped in season. The fact that they lived mostly in caves may be taken as a safe sign of their being largely sedentary.

[4] See D. A. E. Garrod (1934 *b*), p. 138.

in no other microlithic facies that we know of) of a special type of crescent with its back sharpened (or worked) by careful retouch from both faces [1]. The fact that this type (which needs special skill in its making) is very scarce at Hilwan and fairly abundant in the Caves of Wadi al-Mugharah (Mt. Carmel), may perhaps indicate that the Hilwan facies is less specialized than that of Palestine. We may also mention that at Hilwan occur a fair number of long narrow backed triangles and backed blades (compare our Pl. XII, Nos. 38-39) which in Palestine are especially characteristic of the lowest level of the Natufian, or proto-Natufian (Mugharat al-Kibarah) [2]. This does *not* necessarily mean, however, that Hilwan represents an ancestral form of the Mesolithic of this part of the Old World. We have already mentioned (close of preceding Section) that there is still an unknown gap between the late Up. Palaeolithic of N. Egypt and the microlithic of Hilwan (retarded in date). It is perhaps not impossible that both N. Egypt and Palestine received their microlithic industries from some common region so far unknown. At any rate, we must await future discoveries to settle this point.

The importance of this digression into the microlithic industries lies in the fact that there is good reason to think that, chronologically speaking, both the Mt. Carmel and the Hilwan facies represent a survival of microlithic technique into what may be regarded as the Neolithic or Early Post-Neolithic phase. D. A. E. Garrod considers the Natufian to have continued perhaps down to the IVth mill. B. C. (though it started much earlier) [3]. In Egypt we shall see that a microlithic industry of definite Final Palaeolithic descent continued at least to the close of the late Fayyoum industry (Fayyoum B), *i. e.* approximately about the same time as (or a little earlier than) the Natufian.

In Palestine the Natufian seems to have been directly followed by a series of cultures generally known to (French) workers there as the "Eneolithic" industries [4]. These include the Tahounian (*partly* microlithic), the Ghassoulian, the Jerichoan and the Can'aanian [1]. The last (and latest) of these belongs to the full Bronze Age and is considered on archaeological evidence to have coïncided with the rise of Dynasties in Egypt [2]. The Ghassoulian and Jerichoan are older; but they also yielded bronze. Unfortunately the place and nature of the all-important Tahounian still need definition. So far as present excavations in Palestine and Syria go, however, no traces of *true* Neolithic have been found as yet [3]. Although this may represent only a negative fact that may be disproved by further excavations, it is rather puzzling that practically all surface finds of a seemingly "Neolithic" appearance can be reasonably fitted into known cultures of the Eneolithic phase [4]. Many of the

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[1] This gives it a ridged back instead of a blunt one. For this technique see D. Garrod (1934 *b*), Fig. 2. Also compare our Pl. XII, No. 45.

[2] On the industry of Mugharat al-Kibarah see F. Turville-Petre (1932), pp. 271-276.

[3] Garrod (1934 *b*), p. 138. (But see also reference in Vaufrey, 1939, p. 399).

[4] Though there may be some objections to the use of this term, it certainly is a convenient one to cover the Chalcolithic and Bronze Age industries together with others which actually belong

to the same cultural phase though they may not have had any metal. It should be remembered that at this early stage the distinction between true Neolithic, Chalcolithic and Bronze Age was very vague, especially in Palestine where a good deal of survival of cultural elements (even from the Final Palaeolithic) continued at a number of places. See Crowfoot (1937), p. 45 and Garstang (1936), p. 68. Furthermore, the existence of a *pure* Copper Age before that of Bronze in Palestine is still doubtful; see Neuville (1933), p. 6.

[1] On these industries see R. Neuville (1931 *c*), pp. 1-12 and (1930), pp. 199-216; also A. Mallon (1933), pp. 201-211. Also J. Crowfoot (1935), pp. 174-184 and (1937), pp. 35-50, and passing reference in R. Vaufrey (1939), pp. 399 and 406.

[2] See J. Garstang (1936), p. 68.

[3] On this absence of the "Neolithic" *sensu stricto*, see R. Neuville (1930), pp. 201-202 (1931 *c*), p. 10 and (1933), p. 6; also D. Garrod (1934 *b*), p. 138. At one site (the City of Jericho), however, a Tahounian facies is called "Neolithic" because of the absence of any metal (see J. Garstang 1936, pp. 67-76). But this, together with the absence of pottery in the lower layers of the City, may perhaps be considered as negative evidence which may not have any definite chronological value. In this respect it is interesting to note that in the Bronze Age level of the same site, only copper is found (see Garstang 1936, p. 68), yet the flint industry of that level is unmistakably that of the Bronze. This shows the complexity in the dating of successive culture phases in a country where there has been a good deal of survival as well as some local differences in the abundance or scarcity of certain materials. At any rate, we shall see that so far as the flint industry is concerned the Tahounian has no connection with the true Neolithic industries of Egypt; while it, or at least its cognate industries of the Palestinian Eneolithic, have some connections with the Post-Neolithic industries of that country (Egypt), *vide infra*.

[4] There is little reason to accept E. Baumgärtel's conclusions about the existence of a Campignian facies near Mt. Carmel; see E. Baumgärtel and F. Brotzen (1927), p. 111 and E. Baumgärtel (1928), pp. 105-109 (where she also assumes the existence of the same industry in Egypt and N. W. Africa). An examination by the present writer of the Palestinian material in question (Sammlung F. Brotzen, Vorgesch. Abt., Völkerkunde Mus., Berlin, specimens regist. XI, C Dalie I

sites discovered have yielded metal of some sort, though some have yielded only flints and not even pottery. The flint industry is of special value from our present point of view. On Pl. XVII we have inserted a selection of artifacts from various stages of the Eneolithic. Although some of the tools illustrated are more characteristic of one or the other of the Eneolithic stages [1], the industry as a whole may be regarded as a "Group" representing a general cultural phase. We are dealing chiefly with a unifacial blade industry in which bifacial tools are in minority [2]. Polishing is little known and is present only in axes with polished working ends (Plate XVII, No. 2) [3]. Another type of elongated axe (or adze) has its working edge bevelled or re-edged by means of a transversal blow (so-called *"haches avivées"*, Plate XVII, No. 1). As we shall see a little later, the technique of resharpening (or rather re-edging) by means of a transversal blow is found also in some of the Pre-Dynastic industries of Up. Egypt (Armant-Nag' Hammadi area, see Plate XV, No. 8), though owing to certain differences in shape and other morphological details it is difficult to establish any direct connection between the industries of the two countries. Another special class of tools are the arrow-heads which are either of the simple unifacial type (frail blade-points, Plate XVII, 10-13 and 16) or of a somewhat degenerate bifacial one (Plate XVII, Nos. 14-15). The first type is made of narrow frail blades and has a long tang and sometimes only a shank which is worked by fairly steep trimming. It appears to resemble specimens found in Egypt (associated chiefly with Fayyoum B, *vide infra*)and

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und II) has shown the close relation between this industry (mostly made up of chisels and adzes with bevelled or re-edged working ends) and the Eneolithic industries of the rest of Palestine (*vide infra*). Similarly we find no reason for accepting a Campignian industry for either Egypt or N. W. Africa.

[1] Such as the so-called Can'aanian blades (from which the median ridge has been removed); see No. 5 on our Pl. XVII.

[2] We use the term "unifacial" here (and all through the present work) to indicate tools which have been retouched only along their *edges*, though the work on the edges may have actually been applied from both faces. The term "bifacial" indicates specimens which have been flaked all over both *faces* (or practically so).

[3] There is a somewhat superficial resemblance between these elongated axes of Palestine and those of the Fayyoum Neolithic of Egypt (*vide infra*), but the shape and general finish of the tools are not quite identical in both cases.

the S. Sahara (Ounan) [1]. The little bifacial (or largely bifacial) arrow-heads are of a banal character and they represent a seemingly degenerate technique. They are interesting, however, in so far as they show marked differences from the true Neolithic bifacial arrow-heads of Egypt (Pl. XIV, Nos. 4-10) [2]. Knife-blades are abundant in Palestine and are with or without lateral retouch. Sickle-blades resemble the unifacial types of the Pre-Dynastic of Egypt (compare Pl. XVII, Nos. 8, 9 with Pl. XV, Nos. 2, 5-6), though certain specimens are worked on both faces [3]. The burin—an implement which is usually overlooked in industries after the Upper Palaeolithic—is also present in these Palestinian industries (Pl. XVII, Nos. 6-7), and it will be interesting to see (a little later) that it also occurs in Pre-Dynastic times (Pl. XV, No. 7) (and even much later) in Egypt. Other implements include the so-called *"racloir en éventail"*, representing a fan-shaped scraper made of a large thin flake (usually with minutely prepared striking platform) of good (tabular) flint and with its edges often trimmed all round (compare Pl. XVII, No. 17; and *infra*, p. 301) [4]. This interesting implement affords a useful link with the Ma'adi industry of Egypt (*vide infra*) [5]. Other evidence of relations between Palestine (and Syria) and Egypt may be traced in the pottery of the same phase. As we shall see a little later, it is almost generally agreed that the pottery of Middle and Late Pre-Dynastic times has some marked affinities with Syria (and even with Mesopotamia) [6]. Although it is not known whether the diffusion was from the Syrio-Palestinian or from the Egyptian side or whether it reached both countries from a common and still unknown centre, it seems safe to assume that in the case of the flint industry there was reciprocal influence (slight but fairly discernable) from both sides.

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[1] See Pl. XVI, Nos. 1-4, 8-12 and 15-18.

[2] However, they may not be unlike specimens from the Fayyoum B stage of the later Neolithic of Egypt; Pl. XIV, No. 11.

[3] Specimen No. 3 on Pl. XVII is bifacial and in outward appearance it resembles a type of bifacial pointed sickle which started in the Neolithic of Egypt (our Pl. XIV, No. 1), but which is also known to have continued in Pre-Dynastic times.

[4] On this special implement in Palestine see R. Neuville (1931 *c*), pp. 4-5 and his Pl. III.

[5] O. Menghin and M. Amer (1932 *a*), Pl. LXVIII and LXIX, and O. Menghin (1934),Taf. XXI.

[6] On these relations see W. M. Flinders Petrie (1920), pp. 44-50; H. Frankfort (1924), pp. 104 and 118 ff.; A. Scharff (1927), pp. 29-35 and V. G. Childe (1934), pp. 85-129.

Summary of Contact with the North-East.

To sum up the little that we know about the story of Syria and Palestine we find that the microlithic culture "persisted" in this region (or at least in Palestine) to a comparatively late date. Although this industry may have been, in some measure, autochthonous, it seems to have had some kind of connection with the Early industry of Hilwan. The Natufian folk of Palestine were almost certainly acquainted with some form or other of agriculture, though it is not likely that they were in contact with any true "Neolithic" culture (with pottery, etc.). Indeed, up to the present, no strictly "Neolithic" facies has been found either in Syria or in Palestine, and the prospect for finding such a culture as a result of future excavations does not seem to be very bright. At any rate no surface finds bearing even slight resemblances to the pure "Neolithic" industries of Egypt or even drastically different from the Post-Neolithic industries of this latter country (*vide infra*) have been found in this part of S. W. Asia as yet. It is strange, however, that the so-called Eneolithic cultures, as we know them in this latter region, have an essentially local and highly specialized technique. Apart from certain resemblances they could not be attributed to similar industries either on the Iranian Plateau or in Egypt. If the present search for the "Neolithic" fails in Palestine and Syria, we shall be forced to look for the fore-runners of the Early Eneolithic either to the N. or less probably to the S. of this region [1].

NEOLITHIC AND POST-NEOLITHIC CULTURES OF EGYPT. A SYNOPTIC REVIEW; WITH SPECIAL REFERENCE TO FLINT ARTIFACTS.

The Fayyoum Neolithic. A and B Stages. Culture Morphology and Contacts.

Now that we have concluded the survey of the approaches of Egypt, we may proceed to a brief account of the Neolithic and Post-Neolithic in this latter country (see Map 4 on our Pl. XVIII for place names etc.). The recent

[1] If the search for a "Neolithic culture" (in the full sense) in S. W. Asia fails, would that mean that the "Eneolithic" of that region did not pass through a true "Neolithic" stage? This is of course only a possibility, and it remains still unproven.

publications (with accompanying illustrations) relating to these cultures being so comprehensive, we need give here only the main outline of each of them, laying the main stress on features that may betray affinities with the outside world. Perhaps we can best start with the cultures of the Fayyoum Depression, not only because they are amongst the earliest cultures known from Egypt, but also because, thanks to recent work by G. Caton-Thompson and E. W. Gardner, their relations to physiography and climate have been established on a sufficiently firm basis to justify giving them an approximate date [1]. According to Caton-Thompson, the industry may be physiographically and typologically divided into two levels : A and B. Fayyoum A yielded axes and adzes (flaked and polished) of various descriptions (some triangular and having a straight or convex cutting edge, others plano-convex in section), bifacial leaves and points (daggers, javelins, spears), bifacial sickles (some having a bevelled chisel-like transversal end), arrow-heads (triangular in shape or with slightly hollow base or a concave one) and rather crude pottery (including characteristic rectangular dishes with peaked rims) [2]. Although the existence of Mediterranean and Red Sea shells indicates wide commercial relations [3], it is interesting to note that no copper was found. The people lived on a combined system of agriculture (with both barley and emmer), fishing and hunting; but domestic animals seem to have played a negligible part in their economy [4]. Of special importance also is the fact that the examination of the barley from the granaries has shown that in all probability it was of local N. E. African (and certainly not Asiatic) origin, and that it must have been in cultivation long before the rise of the Fayyoum civilization [5].

[1] See their works (1926 *a*), (1929), and more particularly (1934 *b*), (with accompanying volume of plates).

[2] For account on the flint industry of the Fayyoum in general see G. Caton-Thompson (and Gardner) (1934 *b*), pp. 19-22. See also our Pl. XIV, Nos, 1-10. For the pottery see Caton-Thompson (1928 *b*), pp. 70-89 and Caton-Thompson (and Gardner) (1934 *b*), p. 35.

[3] See G. Caton-Thompson (and Gardner) (1934 *b*), pp. 87-88.

[4] We may note the scarcity of the remains of sheep or goat and the absence of their dung from the settlements. For possible reasons for the negligible rôle played by domestication in the Fayyoum civilization see Caton-Thompson (and Gardner) (1934 *b*), p. 89.

[5] Barley grains recovered from the Fayyoum granaries are practically identical with barley grown to-day in Egypt. "Since there has been no appreciable improvement since neolithic

The Fayyoum A is not an isolated culture. As we shall see a little later, it has definite relations with Merimde [Mremdah or Mremdat (Marmadat) Bani Salamah] of the W. border of the Delta and also some affinities with the Badarian of Up. Egypt. It is associated with the 10 m. (above sea-level) Lake of the Fayyoum and (its beginning) is dated approximately at about 5000 B. C. or rather a little earlier (perhaps 5200 B. C.).

The Fayyoum B is a much poorer facies than its predecessor (and to a very marked extent, its ancestor) [1]. It yielded flaked axes and adzes, pebble-butted points and knives (made of tabular flint with cortex left on butt and on part of the back; compare Pl. XIV, Nos. 12-13), gouges, leaf-shaped javelin-points, celtiforms (ranging from bifacial ovates to acutely piriform shapes), planes, etc. [2]. An interesting feature is the substitution by the "tanged" arrow-head of the "concave-based" one, so typical of the Fayyoum A facies (compare Pl. XIV, Nos. 6-10 and 11). It is curious, however, that no Neolithic pottery has been found in the settlements of the B Level. Indeed it is obvious that, in a sense, this phase represents a degeneration of the earlier Fayyoum culture. This is also supported by the co-existence with the Fayyoum B of a microlithic (or partly microlithic) culture which makes only a furtive appearance in the A group [3]. The microliths are chiefly narrow backed blades (usually long but sometimes quite microlithic), narrow "*limaces*" (double backed blades or "*lamelles à deux tranchants rabattus*"), trihedral rods and shanked or tanged slender blade-points (compare Pl. XVI, Nos. 15-23). G. Caton-Thompson inclines to see in this facies a Capsian element settled in the Fayyoum [4]. It should be made clear, however, that the geometrical forms and the micro-burin (two keynotes of the late Capsian) are conspicuously absent from the

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times", so A. Jackson puts it, "a very long time must have been needed for this barley to have developed from a wild grass to the state of perfection which this [*i. e.* the Fayyoum] specimen shows : in other words, the origin of agriculture must have been long before the date of the Fayum neolithic period"; see A. Jackson's report in Caton-Thompson (and Gardner) (1934 *b*), pp. 46-48, and 88 (reference on p. 48); also his work (1933), p. 652.

[1] But Fayyoum B throws more useful light upon culture contacts of Egypt.

[2] See G. Caton-Thompson (and Gardner) (1934 *b*), pp. 19-20.

[3] On this microlithic facies see G. Caton-Thompson (and Gardner) (1934 *b*), pp. 58-59.

[4] G. Caton-Thompson (and Gardner) (1934 *b*), pp. 55 and 90.

Fayyoum [1]. On the other hand, the industry shows some similarities with the microlithic one of Hilwan (and Wadi 'Angabyyah), which differed from the Capsian in having no burins or micro-burins, and very few (and no true) geometrical forms. It is not improbable that as at Hilwan, the Fayyoum facies of microliths persisted for a long time (into Fayyoum B stage), though it did not become overwhelmed by the contemporary and more advanced culture. But the microlithic (or partly microlithic) forms of the Fayyoum are of still more interest in the culture complex of late prehistoric times in Egypt. The shanked or tanged frail blade-points and the trihedral rods occur farther South (where they are somewhat larger in size), especially in the Khargah Oasis (compare Pl. XVI, Nos. 8-14) [2]. It is interesting that these peculiar implements, especially the frail blade-points, are most characteristic of the Ounanian industry of the S. Sahara [3], and that some forms of them are also found in the Eneolithic industries of Palestine (*vide supra,* also Pl. XVII, Nos. 10-13 and 16, especially 11-13). Of course it may be contended that the existence of these types of implements in such rather widely separated regions as Ounan, Khargah, Fayyoum and Palestine may have been due purely to chance or independent discovery; but the facts that they (especially the shanked points) do not occur in any other (surviving) Final Palaeolithic industry that we know of, and that at Ounan they exist almost unmixed with any other facies (unlike the case in Egypt and Palestine) lend special significance to their distribution. The facts that the trihedral rods of the Fayyoum are much better finished than those of either Khargah or Ounan (compare specimens Nos. 6, 9 and 14 and 19-20 on Pl. XVI), and that the industry of the latter station is on the whole cruder and larger (not really microlithic at all) make it quite probable that the

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[1] Should these even turn up from the Fayyoum, they are likely to be of very rare occurrence. The present writer has seen one rather uncertain micro-burin in a private collection in Cairo (Ch. Bachatly Eff.) said to have come from the Fayyoum.

[2] See Coll. of al-Mat-haf al-Misri (Cairo Museum) specimens regist. 64258-70 (also photographed in C. T. Currelly 1913, Pl. XXXVII) and 55632-35 and 59537-38, 41, 50 and 55-59. The prismatic rods of Khargah are much cruder than those of Fayyoum. The latter are sometimes made of natural "*Dreikanter*" pieces which have been retouched on their three faces.

[3] Coll. of the Mus. Trocadéro (now *Musée de l'Homme,* Paris) specimens regist. 33.19.535-40 49 and 62. See also our Pl. XVI, nos. 1-7.

spread of these types was from the S. Sahara into Khargah and thence to Fayyoum [1] and perhaps as far as Palestine. The spreading must have taken place during the "Neolithic" wet phase when the expansion of many (surviving) Final Palaeolithic and other cultures was going on on a large scale.

But the Fayyoum B industry had other wide culture-associations. A culture partly similar, though showing certain radical differences, has long been known from Siwah (Siwa) [2]. One of the chief similarities between the lithic industry of this latter and that of the Fayyoum is the extensive use of points and knife-points made of tabular flint. In Siwah, however, the broad willow leaf and the narrow javelin (with plano-convex cross-section) assume a distinctly local character. As in the Fayyoum, there is a microlithic (or semi-microlithic) industry made up almost exclusively of long backed blades and long triangles; but the contemporaneity of this industry with the Neolithic one is not certain. Other Fayyoum B affinities are to be found sporadically in the W. Sahara (Tabelbalat, etc.). There, as we have already mentioned, we find knives made of tabular flint on the same technique as in Fayyoum B (*i. e.* with cortex left on butt or on butt and one of the sides; compare Pl. XIV, Nos. 12-15), and also other probably later Egyptian influences. Of these latter, the pistiliform arrow-head (see Pl. XIV, Nos. 28-32) links up with the Proto-Dynastic (or Late Pre-Dynastic to Early Dynastic) phase.

The Fayyoum B is associated with the 4 m. Lake level and the beginning of the -2 m. level of the Fayyoum; and it (its beginnings?) may be approximately dated at 4500 B. C. It may have been partly contemporary with (and was almost certainly superseded in the Fayyoum by) ordinary Pre-Dynastic facies similar to those to be mentioned later from the Valley itself [3].

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[1] The writer is informed by a former resident in Luxor that implements showing (superficial?) resemblances to the shanked type have been found at Laqitah in the desert E. of Luxor.

[2] See Mus. of Arch. and Ethn. (Cambridge), Coll. given by C. W. Cunnington, specimens regist. 24.1114 (also 24.1113 for microliths). See also reference in G. Caton-Thompson (and Gardner) (1934 *b*), p. 94. A small series of implements from the region of Siwah has also been given to the Alexandria Museum by Cunnington, registered as No. (inv.) 21664, and by H. W. Seton-Karr, registered as Seton-Karr.

[3] It may thus be noted that the Fayyoum B can be regarded as "Neolithic" only in so far as it yielded no metal. Chronologically speaking, however, it was in fact contemporary with Early Chalcolithic in the Valley proper.

The Neolithic Settlement of Merimde (Mremdat Bani Salamah), W. Delta. Parallels and Contacts.

Another purely Neolithic industry of L. Egypt is that of Merimde Beni Salame (Mremdah or Mremdat Bani Salamah) [1]. It may save repetition to say that in practically all its essentials this industry is identical with the Fayyoum A culture. A close examination of the flint industry may perhaps show that although there is a number of finely finished specimens, there are also many leaf-points of rather cruder workmanship than in the Fayyoum [2]. On the other hand, Caton-Thompson finds good reason to think that the ceramic technique of Merimde is definitely in advance of that of Fayyoum [3]. However this may be, it is evident that the two industries belong to one and the same culture-group and phase [4].

Certain ethnographic differences between Merimde and Fayyoum A are perhaps worth mentioning. The relative abundance of the sickles (as compared with arrow-heads) at the former, may suggest that the people depended more on cultivation than on hunting. Also the fact that remains of pig are

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[1] On this see works by H. Junker (1928), (1929), (1930 *a*), (1932), (1933) and (1934): also O. Menghin (1933), pp. 82-97 (where he makes a comparison with Maʿadi). See also material in the Kunsthist. Mus. (Vienna) and the al-Mat-haf al-Misri (Cairo Museum).

[2] We may add, however, that the flint and stone industry is of a varied character (see H. Junker, 1929, pp. 177-178 and 219-223 and (1930 *a*), pp. 61-71). Of special interest and importance is a large series of polished axes and adzes. The polishing technique is even represented by a unique specimen of a ground and polished dagger. Other weapons include mace-heads of the pear shape and a large number of bifacial artifacts. Arrow-heads are mostly hollow based, but the tanged type is also represented. There are also triangular javelin- or spear-heads. Long triangular and square-based bifacial sickles are especially abundant; and so are the other bifacial tools, especially knives. On the other hand, the unifacial or blade industry is very scanty. A number of exceptionally crude core-tools (sling-stones? etc.) are also present.

[3] G. Caton-Thompson (and Gardner) (1934 *b*), p. 92. Apart from various vessels, there are, at Merimde, fragments of handles (?) and also of mud figurines. For an account on the pottery and mud-work of Merimde see H. Junker (1929), pp. 226-237, (1930 *a*), pp. 72-73 and (1932), pp. 68-81.

[4] See H. Junker (1929), pp. 180-184; and G. Caton-Thompson (and Gardner) (1934 *b*), p. 91. Compare also S. Huzayyin (1937), footnote 2 on p. 194.

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fairly abundant there [1], while they are scarce in the Fayyoum, may indicate that domestic animals played a more prominent part in their economy [2]. But the most important difference between Fayyoum and Merimde lies in the arrangement of the settlement itself. In the former region the settlements were not only small in size (and scattered along the edge of the Lake), but no "plan" of the habitations could be established. Merimde, on the other hand, was a huge village (approx. 600 × 400 m.) and had some of its huts arranged in two definite rows, leaving a lane between [3]. It is clear that this indicates a higher social organization on the borders of the Delta than in the Fayyoum [4]. Also in Merimde the burials lay within the village [5], while in the Fayyoum the settlements have yielded no such burials. Caton-Thompson suggests that the dampness of the soil in the settlements by the side of the Fayyoum Lake may explain the non-existence of burials amongst the huts; and of course this may be supported by the fact that the granaries in the Fayyoum were placed at a high level above the Lake [6]. Unfortunately no burials, even outside the settlements, have been found in the Fayyoum as yet [7]; and the question of any ethnological differences (such as methods and conditions of burial and other features that are not governed by the milieu) must remain an open one.

Another N. Egyptian culture, which seems to be directly connected with the Fayyoum A and Merimde industries in that of al-ʿUmari, to the N. of

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[1] See H. Junker (1929), p. 218; also O. Menghin (1933), p. 88, where this latter writer makes the interesting generalization that whereas pig culture was notable in L. Egypt, it was much more scarce in Up. Egypt. His remarks, however, about the abundance of pig remains in the Fayyoum do not seem to be corroborated by statements by Caton-Thompson (and Gardner) (1934 *b*, pp. 25, 34 and 89).

[2] There is no reason to consider the abundant bone remains of Merimde as being those of hunted wild boar.

[3] This is perhaps the earliest "plan" of a village to be discovered. See H. Junker (1933), pp. 57-64 and Fig. on p. 59.

[4] It must have meant something in a prehistoric village that the villagers did not build up their huts hap-hazard, but according to plan.

[5] On such burials see H. Junker (1933), pp. 72-77.

[6] See G. Caton-Thompson (and Gardner) (1934 *b*), p. 91.

[7] One such burial is reported (May 1937) to have been found by a certain Mr. Townsend and others, but the association of this burial with the Fayyoum culture is still unproven.

Hilwan [1]. Unfortunately, this site has been only very partially excavated, and hardly any clear information is available. All that can be said from the examination of the pottery and the flint industry is that it links up with the Early Neolithic cultures of the western side of the river.

The Chalcolithic Settlement of Maʿadi. Cultural Links with the N. E. Approach.

The last settlement for us to consider in this part of Egypt is Maʿadi [2]. This represents a much later industry which falls well within the Chalcolithic. Its flint industry contains a few bifacial pieces; but, in the main, it is made up of blades which are either simple or only retouched on the edges [3]. This may be sufficient in itself to separate it from the true Neolithic industry of Fayyoum A and Merimde (and al-ʿUmari) and to link it to the "Pre-Dynastic" flint facies [4]. It is interesting that the typical hollow-base arrow-head of the "Neolithic" is absent and that its place is taken by other types of Pre-Dynastic and Proto-Dynastic times [5]. There are also scrapers of various descriptions, which include the *"racloir en éventail"* or fan-type (see Menghin and Amer, 1932 *a*, Pl. LXIX, Nos. 1 and 2 and Pl. LXX, Nos. 1 and 2 and O. Menghin, 1934 *a*, Taf. XXI; also our Pl. XVII, No. 17) which—as we have already seen; *vide supra*, p. 293—occurs also in the Eneolithic (especially Early Bronze) of Palestine [6]. Another implement which, after being absent from the Neolithic

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[1] On this see P. Bovier-Lapierre (1926), pp. 266-282 and (1926 *a*), p. 306; also private collection of same author (Collège des Jésuites, Cairo).

[2] On this see O. Menghin and M. Amer (1932 *a*) and (1936); and O. Menghin (1932 *d*), pp. 143-147 (1932 *f*), pp. 150-154 (1932 *g*), pp. 108-109 and (1934 *a*), pp. 111-118; and M. Amer (1932), pp. 5-16 (1933), pp. 140-143 (1934), pp. 170-171 (1934 *a*), pp. 176-178 (1936 *a*), pp. 8-17 and (1936 *b*), pp. 65-69. Also Coll. of Geog. Dept. (Fuad I University, Cairo).

[3] See O. Menghin and M. Amer (1932 *a*), Pl. XLIX-LVII, and (1936), Pl. LIII-LXI.

[4] For the difference between the true "Neolithic" (bifacial) and the Pre-Dynastic (largely unifacial) techniques, contrast our Plates XIV, Nos. 1-10 and XV, Nos. 1-6. (See also S. A. Huzayyin, 1937, pp. 193-199.)

[5] See O. Menghin and M. Amer (1932 *a*), Pl. LVI, Nos. 12 and 13; compare with our Pl. XIV, Nos. 28-30 (pistiliform type). It may be added that Pre-Dynastic fish-tail knives have also been found at Maʿadi; see O. Menghin (1934 *a*), Taf. XX *a*. Two transversal (microlithic) arrow-heads have also been discovered in the 1939 season of digging.

[6] This is a particularly fine implement made of a large thin flake, with a neatly prepared

and presumably also the early Chalcolithic of Egypt, appears in Maʿadi (and some other Pre-Dynastic settlements, *vide infra*) is the burin [1]. Interestingly enough, this implement is also known from the Eneolithic of Palestine [2]. The people of Maʿadi seem to have used copper fairly extensively, and this was presumably imported from Sinai [3]. Other, perhaps less definite, connections with the East are shown in the pottery, some of which may have been imported from Syria-Palestine [4]. It is clear therefore that Maʿadi represented a culture of fairly wide contacts [5]. Although it cannot be decided with certainty whether the similarities between it and certain Palestinian industries are due to diffusion from or towards Egypt, the latter alternative is (for the present) the more likely. It should be made clear, however, that, taken as a whole, the culture of Maʿadi is distinctly Egyptian in its essentials.

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striking platform and fine trimming applied all round its circular or oval edge from the upper (or dorsal) surface of the flake. This upper surface retains the original cortex which is only removed from the edges by trimming. The lower (or ventral) surface of the flake is flat (except for the well marked bulb) and it usually shows no traces of working. The thickness of the tool at its edges is usually only a few millimetres.

[1] Numerous specimens of this special implement can be identified in unpublished material from Maʿadi. The burin has also been found in the Pre-Dynastic settlement of Armant in Up. Egypt (to be mentioned later). (See also our Pl. XV, No. 7.) There is even good reason to believe that this implement (especially useful for engraving on stone) continued to be used in Dynastic Egypt. We have identified it amongst a collection of tools from Dynastic levels in Armant (see S. A. Huzayyin, 1940, pp. 69-72).

[2] See R. Neuville (1933 *a*), p. 130 and Fig. 14, Nos. 5 and 6 (and our Pl. XVII, Nos. 6 and 7).

[3] See O. Menghin and M. Amer (1932 *a*), p. 48 and M. Amer (1936 *a*), p. 14 (where reference is also made to the importation of manganese ore from Sinai).

[4] On this question see O. Menghin and M. Amer (1932 *a*), pp. 26-27; also O. Menghin (1934 *a*), p. 113 and M. Amer (1936 *a*), pp. 11-12. In the 1940 Season of digging Prof. M. Amer has discovered in the settlement a head of a statuette of baked mud. Interestingly enough, the statuette appears to represent a racial type similar in appearance (beard etc.) to representations of S. W. Asiatic folk (?) in Egyptian (historic) drawings and paintings. Information kindly given by Prof. Amer.

[5] In fact trade seems to have played an important part in the economy of the Maʿadi society (see M. Amer, 1936 *a*, pp. 11-12). The people cultivated wheat and barley, but so far as the flint industry reveals, the proportion of tools used in cultivation is rather limited. The social economy must have been based on a complex system of cultivation, animal-breeding, trade and some fishing and hunting.

In fact, it retains some of the Merimdian traditions not only in pottery, but also in the type of life and the organization of the settlement. As in Merimde, pig breeding constituted an important item in the economy of society [1], while the village itself was exceptionally large (extending over one and a half kilometres) and contained some burials within it [2]. In its main aspects, therefore, it represented a local Egyptian tradition, which was enriched by outside contacts [3].

The exact chronological place of Maʿadi is difficult to determine. Menghin and Amer have at first [4] placed it in the closing stage (Semainian, *vide infra*) of Pre-Dynastic times; but Menghin has lately preferred to equate it with the Middle (Gerzean, *vide infra*) and Late (Semainian) stages of that phase [5]. As it stands, this latter view may at first appear to be rather difficult to reconcile with the admitted connections between Maʿadi and the Early Bronze Age of Palestine, as only few Palestinian prehistorians would be prepared to place the Early Bronze of that country in the same chronological place as the Gerzean of Egypt [6]. It may be reasonably assumed, however, that although

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[1] An interesting point of difference, however, is that while bones of donkey appear at Maʿadi, they are absent from Merimde. It appears that this animal, which is of African origin, did not reach N. Egypt until the time of Maʿadi; see O. Menghin (1933), p. 88.

[2] Human bones were discovered sporadically within the settlement, and an interesting grave was found by Prof. M. Amer in the 1934 season (see M. Amer 1936 *a*, p. 10 and Fig. 10). It should be noted, however, that unlike the burials of Merimde, that of Maʿadi contained offerings. Another interesting burial was that of a child's skeleton found in big pot (see M. Amer 1936 *a*, p. 11 and Fig. 9).

[3] The dwellings discovered at Maʿadi were of the ordinary hut-type. But some three or four artificial cave-dwellings have also been discovered by Prof. M. Amer within the settlement. These were excavated in the virgin soil of consolidated wash and sub-aereal formations (cemented coarse sands with other angular surface-wash material). See M. Amer 1936 *a*, p. 9 and Figs. 3 and 4. Such artificial sub-terraneal dwellings have not been previously recorded from prehistoric Egypt. Could their existence reflect further on connections with Palestine, where (natural) cave-dwellings were fairly common in prehistoric times? This, however, is a remote speculation. Pre-Dynastic Egyptians knew only huts partly sunk in the ground.

[4] O. Menghin and M. Amer (1932 *a*), pp. 56-59.

[5] O. Menghin (1934 *a*), pp. 117-118.

[6] Indeed evidence has been brought up recently (from Jericho) that the rise of the Bronze Age in Palestine may have been contemporary with that of Dynastic Egypt (or at least with the closing stages of the Pre-Dynastic phase); see J. Garstang (1936), p. 68.

the culture of Maʿadi may have started at the same time as the Gerzean, it survived well into the Late Pre-Dynastic. The connections it had with Palestine may not have existed before this Semainian stage [1].

The Neolithic and Early Chalcolithic of Up. Egypt. Tasian and Badarian.

We may now pass on to a brief account of Up. Egypt. The oldest and only pure Neolithic (yielding no traces of copper) culture known from here is the Tasian (Deir Tasa) [2]. This culture, however, is still only partially known. Its stone industry includes relatively few bifacial types (and has thus far yielded only one hollow-base arrow-head), which would rather tend to distinguish it both from the "Neolithic" cultures of N. Egypt and from the Badarian of Up. Egypt [3]. The existence, however, of a special type of polished axes of siliceous limestone which have also been found in the Khargah Oasis and the Fayyoum shows that the Tasian was by no means an isolated culture [4]. There are also certain rough oval-shaped and elongated chipping-knives made of tabular flint and retouched only on the edges (leaving cortex in centre on both faces) [5]. Similar, though perhaps not quite identical, implements have been found also in flint mines not far from Khargah [6]. The pottery includes

[1] As already pointed out, the Maʿadi site is a very extensive one. It is possible that there has been a lateral shift (irregular) of the settlement as time went on. When the large collection of material excavated within the last few seasons is fully worked out, it may ultimately show that the settlement covered an unusually long span of time. The site may thus exhibit some kind of "lateral" or "horizontal" stratification.

[2] From region of Deir Tasa; see S. Gabra (1930), pp. 147-158; also recent publ. by G. Brunton on *Mostagedda,* London, 1937. Also reference in A. Scharff (1931), pp. 15-16.

[3] On the flint industry see S. Gabra (1930), pp. 155-157 and Pl. II and G. Brunton (1937), pp. 7-33 and Pl. XXVI-XXVIII. Also Coll. of al-Mat-haf al-Misri (Cairo Museum) and the Brit. Museum (London).

[4] See S. Gabra (1930), pp. 151 and 156 and G. Brunton (1937), p. 32 and Pl. XXVI; compare with G. Caton-Thompson (1934 *b*), p. 26.

[5] See Coll. of Mus. of Archaeology and Ethn. (Cambridge), five specimens regist. 31935. A. E. (from Tasa). G. Brunton (1937, p. 31 and Pl. XXVI, Nos. 41, 44 and Pl. XXVII, Nos. 3, 4, 44, 45, 47, etc.) considers these implements as Tasian, though it is not absolutely certain whether they really belonged to the true Tasian or to a somewhat later phase.

[6] See Coll. of al-Mat-haf al-Misri (Cairo Museum), specimens registered 55650, 55652, 58124 and 58151.

some of the rippled pots of Badari, together with some tulip forms (with incised and white encrusted patterns of hatchings) which are characteristic of Tasa (Deir Tasa). S. Gabra thinks, however, that in other respects the ceramic industry bears certain affinities—however remote these may be—with Merimde (Mremdah) [1]. It seems, at any rate, that although the Tasian represents an essentially Up. Egyptian industry it had certain relations with other parts of Egypt in both the N. and the West [2]. Its chronological place may be roughly fixed as equivalent (at least in part) to the true Neolithic of the North [3].

With the Badarian culture we pass into the Chalcolithic. Thanks to work by G. Brunton and G. Caton-Thompson, the status of this industry amongst the Neolithic and Post-Neolithic cultures of Egypt can be fixed with more certainty [4]. The lithic industry is chiefly characterized by its bifacial forms which include points, javelins and arrow-heads [5]. These latter may be linked up with Fayyoum hollow-base types. The points, on the other hand, are of a more specialized technique, and find their parallel only in the Khargah region [6].

[1] S. Gabra (1930), p. 154.

[2] Although it may be said that some of the northern elements in the Tasian may represent a southward diffusion, the relations with Khargah are not quite clear as yet. From circumstantial evidence, however, it seems more likely that the diffusion of Neolithic elements was chiefly (though not entirely) from the Valley towards the Oasis rather than in the opposite direction.

[3] It is possible, however, that the Tasian (or certain elements of it) may have survived in Up. Egypt to overlap with the Badarian. (See G. Brunton 1937, pp. 8 and 32, where reference is made to the difficulty in dating Tasian material and to the overlap with Badarian.) The present writer finds reason to think that, in the Mustagiddah (Mostagedda) area, the survival of Tasian tradition may have continued even into the Early Pre-Dynastic (see S. A. Huzayyin, 1937, pp. 196 and 229).

[4] See work of G. Brunton and G. Caton-Thompson (1928); also G. Brunton (1929), pp. 456-467 and (1937).

[5] There is no good reason to think that the Badarian flint industry is derived from the Tasian. The pottery of the two cultures shows marked affinities, but it is interesting to note that the human remains associated with the two groups show marked physical differences. It is probable that we are dealing with two ethnic and cultural groups which may have come into contact with each other during the later stages of the Tasian. See G. Brunton (1929), p. 466 and (1937), pp. 32-33.

[6] See G. Caton-Thompson (1931 *a*), Fig. 1.

Simple flakes are not lacking, and are found even in graves (suggesting that they were usable?). The pottery is of exceptionally fine quality and form. Some of the specimens are more finely finished than any made later [1]. It falls into several categories including polished Black-Topped (grey-brown or red), polished Red and all-Black [2]. So far as is known the only parallels with this pottery (or rather part of it) are to be found in the following phase (the Amratian), to which reference will be made shortly. The people of Badari cultivated emmer and probably knew the domesticated (?) ox, sheep, and goat [3]. Remains of pig have not been recorded [4], and should they turn up from future discoveries, they would presumably be far scarcer than in settlements of L. Egypt (Merimde and Ma'adi). The Badarians seem also to have had wide commercial relations, ranging to Red Sea (from which shells were procured) and perhaps even as far as Syria [5]. Human bone remains suggest prognathism, but similarities with negroid types of the S. are so distant and slight that in no way do they suggest a direct connection between the two [6]. Indeed, even if we admit that the Badarians had in them certain elements from the S. E. Desert of Egypt and perhaps the E. Egyptian Sudan, their connections with the N. cannot be overlooked. Of special interest, however, is the fact that when Badarian culture came to an end in Up. Egypt proper, certain elements of it seem to have been pushed southwards into Nubia, where they survived well into the late prehistoric culture phase of that region (*supra*).

So far as chronology is concerned the Badarian culture may be placed at a slightly later stage than the (Tasian and the) true "Neolithic" of the North; but it is certainly earlier than the first "Pre-Dynastic" stage (Amratian, *infra*).

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[1] See G. Brunton (1929), p. 463.

[2] On the classification of this pottery see G. Brunton (1928), pp. 20-26.

[3] See G. Brunton (1928), p. 38; and G. Caton-Thompson (1928), p. 77.

[4] A statement made by present writer (1939, p. 241) about some scarce pig bones found in Badari area relates to settlement remains of Pre-Dynastic and *not* Badarian date.

[5] Syrian connections are suggested by the existence of four handled pots of hard pink ware. There are also basalt vases (perhaps from somewhere in N. Egypt?). See Brunton (1928), p. 41.

[6] See B. N. Stoessiger (1927), pp. 110-150, especially, p. 147; also G. Brunton (1928), pp. 20 and 68. In this connection it should be remembered that the hair is generally wavy, with a few cases of either straight or curly hair.

The Area of Armant-Naqadah-Nag'Hammadi and the Chalcolithic of Upper Egypt.

Another recently excavated Up. Egyptian industry which bears some connections with Badari, but whose date may be roughly fixed as Early and Middle Pre-Dynastic, is that of Armant [1]. Some Badarian pottery was found in the settlement, but there is no conclusive evidence as to its Badarian date. Other types of pottery may be correlated with Early and Middle Pre-Dynastic ware. The flint industry is, on the other hand, of very special character (compare Pl. XV, Nos. 5-8). It is made up mostly of axes with a sharpened or re-sharpened "*tranchet*" (made by striking a transversal flake off the cutting edge of the tool—compare Pl. XV, No. 8), blade sickles (Pl. XV, Nos. 5-6), scrapers of various descriptions, triangular gouges with plano-convex section (similar to those of Fayyoum B), and, last but not least, burins (Pl. XV, No. 7). Bifacial types are rather rare, and so are arrow-heads. Simple and retouched blades (including the sickles) are fairly well represented [2]. So far as the

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[1] See Sir Robert Mond and O. H. Myers [with chapters by others] (1937).

[2] The flint industry of the Armant settlement has been studied in detail by the present writer; see S. A. Huzayyin (1937), pp. 201-225 and 231-250. Among the most debatable classes of tools found there are big boring implements with long and neatly prepared necks and well sharpened working tips (*ibid.*, pp. 212-214 and Pl. LVIII, Nos. 38-43 and LXIV, Nos. 32-37). It was then suggested that these implements may have served as dibbles or digging picks (used in making holes in the ground for burying seeds in cultivation). The writer is now more inclined to consider them as big borers used for making holes or slots in wooden (or other) handles in which axes, adzes, etc. were hafted. In a visit (1938) to the Copenhagen National Museum a few specimens of big borers almost identical (typologically) with Egyptian ones were noticed by the writer. One specimen is registered as belonging to the Maglemose culture, while a few are attributed to the Kjökkenmödding phase (*e. g.* specimen regist. A 1994 in case 7, Room 2) or are of uncertain date (*e. g.* specimen regist. A 35432 in case 19, Room 1). See also T. Mathiassen (1934), Pl. II. It is probable that these Danish implements were used for making holes in horn handles of axes, etc. Another interesting class of tools at Armant (and which also occur in other settlements both in S. and N. Egypt) are other Palaeolithic-like artifacts. We have been able to point out (S. A. Huzayyin, 1937, especially pp. 226-227) that the existence of such artifacts in Neolithic and Post-Neolithic Egypt can lend no support to the view suggested by certain workers (E. Baumgärtel, 1928, pp. 105-109, and more definitely O. Menghin, 1932, p. 16 and 1932 *b*, p. 88; also reference in A. Scharff, 1931, pp. 7-8) that the earliest Neolithic of Egypt may represent a cognate development to the Campignian of Europe, both starting from some common source with surviving L. Palaeolithic

material goes, only two ornamental copper pins were found, but there is circumstantial evidence that other copper tools may have been used [1]. A flint industry very similar to this has been collected by Vignard from the surface of a station near Nag'Hammadi, and—on the evidence of the burin—he took it to be of Aurignacian technique [2]. Of course his conclusions are no longer tenable, now that this lithic industry has been found in definite association with Pre-Dynastic pottery, etc. at Armant. Indeed, sharpened and re-sharpened axes (*"haches avivées"*) similar to those of Nag'Hammadi have been known from Pre-Dynastic kitchen midden material (at Naqadah) since the close of last century [3]. Unfortunately these latter finds (which also include triangular gouges) were discovered before any detailed information about the Pre-Dynastic phase was available, and little is known about the stratification or the conditions of settlement. At any rate there is good reason to think that they represent an industry closely associated to those of Armant and Nag'Hammadi. It seems that, during at least part of the Pre-Dynastic phase, the region between the latter two stations [on the western side of the Qina (Qena) bend of the Nile] constituted a culture-area on its own. A few links, however, are

tradition. The date of the surface implements discovered at Wadi al-Sheikh (esh-Schêch) and which largely gave rise to this view (see E. Baumgärtel, *ibid.*, also A. Scharff, *ibid.*) is by no means certain. The site (discovered largely by Seton-Karr) may represent a chipping factory near some flint mines of late prehistoric or even historic date (?). The resemblances between its artifacts and the Campignian technique may be quite superficial. We may further note that the Campignian does not exist in N. W. Africa, though a Campignian-like facies is said to have been found there, associated with the L. Palaeolithic (see M. Reygasse, 1934 *a*, pp. 1-3).

[1] Verbal information kindly given by O. H. Myers; also Sir Robert Mond and O. H. Myers (1937), p. 190.

[2] See Ed. Vignard (1929), pp. 299-306 and accompanying Figs.

[3] See J. de Morgan's work (1896); also Collections of the Inst. de Paléont. humaine (Paris), specimens regist. 1919.1 (pub. in H. Breuil, 1931, p. 85 and Fig. 64), and of the Völkerkunde Museum (Vorg. Abt.), Berlin, specimens regist. X 40-45 (pub. in E. Baumgärtel and F. Brotzen, 1927, pp. 106-109 and Abb. 2). As we have already mentioned (*vide supra*, also our Pl. XVII, No. 1) elongated *haches avivées* of a different type and technique also occur in the Eneolithic of Palestine (see A. Mallon, 1925, Fig. III, No. 22; also Sammlung Brotzen in the Vorg. Abt. of the Völkerkunde Museum, Berlin, specimens regist. XI, C Dalie I und II). So far as we can judge from a comparative study of the Egyptian and Palestinian industries, they seem to belong to two different facies.

provided with some newly discovered industries at Mustagiddah (Mostagedda near Badari and Tasa on the eastern bank of the river) [1], with the Khargah region [2] and even with the Fayyoum B culture in the North [3]. It may be, therefore, stated that although this Armant-Naqadah-Nag'Hammadi culture may have been distinctly local and Upper Egyptian in origin and character, it was not entirely out of touch with other areas (even in the North). As already mentioned, the date of the Armant settlement may be roughly stated as Early and Middle Pre-Dynastic, though it is possible that the culture, especially at Naqadah, continued right through Late Pre-Dynastic times. The fact that, as we shall presently see, its lithic industry is different (in many respects) from any that we know from the ordinary Pre-Dynastic cultures (*vide infra*), indicates that this latter phase may prove to be of a more complicated nature than hitherto supposed.

The Pre-Dynastic Phase (sensu stricto). *Its Three Stages : Early, Middle and Late. Contacts with the Near East. The Close of the Prehistoric Phase and the Dawn of History.*

The culture-groups of the ordinary "Pre-Dynastic" (*sensu stricto*) phase and their outside relations have been the subject of extensive studies [4]. Except for certain complications, to be referred to later on, and for his exaggerated absolute chronology, the original scheme worked out by Flinders Petrie still

[1] Here were found both re-edged axes and planes. See G. Brunton (1937), Pl. XXVII-XXVIII.

[2] In Khargah were found re-edged axes and big borers. Information kindly given by G. Caton-Thompson. See also her forthcoming publication(with E. W. Gardner) on Khargah perhaps in a *Mém. de l'Institut d'Égypte* (?), Le Caire.

[3] The link with the Fayyoum B is represented by the gouges or planes with plano-convex cross-section. For specimens from the Fayyoum see G. Caton-Thompson (1934 *b*), p. 20 and Plates XXXIV, 8-10 and XXXV, 1-4, 7 and 9.

[4] See especially W. M. Flinders Petrie (1920), pp. 46-50, and A. Scharff (1927), pp. 15-46. Also comparative studies by H. Frankfort (1924). We use the term Pre-Dynastic here in the strict sense used by Flinders Petrie, and which includes the three classic stages of the Amratian, Gerzean and Semainian. We differ, however, from Petrie on matters of absolute chronology and on certain other points of detail (*vide infra*). The type station of the Amratian is al-'Amrah (or el-Amrah, Cemeteries) and that of the Gerzean is Girzah (or Gerzah, Cemeteries). That of the Semainian is al-Samaynah (Semainah) to the E. of al-'Amrah. Both of these latter

holds good [1]. It is generally agreed that the Amratian (Early Pre-Dynastic) represents an essentially local (Egyptian) development. It is now known from a fairly large number of settlements from Badari southwards. Its flint industry differs from that of Badari in the fact that it is predominantly unifacial [2]. There are some bifacial tools, but they are distinctly in minority. There is an abundance of simple blades and scrapers. The industry has so far yielded no flaked and re-edged axes (of the Armant type); but it includes mace-heads which were never found in the Armant-Nag' Hammadi area. There is also a relatively small number of polished axes. But the pottery of this stage is of special interest. Its chief characteristic ware is the Black-Topped, which, as we have already seen, occurs in the Badarian. Some of the vases (pots) and amulets bear representations of such animals as crocodiles and scorpions [3], which may indicate the existence of a totemic cult. A number of

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two are in Up. Egypt, while Girzah is in Middle Egypt. For place names in prehistoric Egypt see Map 4 on our Pl. XVIII. Certain authorities (such as A. Scharff 1927 and 1931) prefer to use the term Naqadah (Negâde) culture for the whole of the Pre-Dynastic phase (*vide infra*). This may be justifiable on the ground that at al-'Amrah itself there are remains belonging to both the Amratian and the Gerzean cultures (see A. Scharff 1931, footnote 2 on p. 20). We shall use here, for preference (though not invariably), the terms Early, Middle and Late Pre-Dynastic. But the term Early Pre-Dynastic itself has sometimes been used by certain workers (see R. Mond and O. H. Myers, 1937, footnote 1 on p. 6) to cover the Amratian together with some other earlier cultures (including true Neolithic). This is not entirely justifiable on technological grounds. On the other hand, the term Proto-Dynastic is suggested by Myers (and Mond, *ibid.*) to cover that part of the Late Pre-Dynastic occupied by the *so-called* Dynasties (or Proto-Dynasties) which preceded the 1st Dynasty of *historic* Egypt. This latter suggestion we have adopted here. But the whole question of nomenclature in late prehistoric Egypt remains open to discussion and controversy. It is a matter that could be settled only by agreement in a conference, which is a *desideratum* for the future! For the moment, no author can do more than make clear the connotation of the terms he uses.

[1] The system of *relative chronology* or Sequence Dates (abbreviated as S. D.) worked out by Flinders Petrie (*e.g.* 1901 and 1920) remains practically unchanged. According to his scheme, the Amratian covers S. D. 30-38, the Gerzean S. D. 39-63 and the Semainian S. D. 64-78 (79 coïnciding with rise of Dynasties). S. D. 1-29 were left by Petrie for any earlier cultures that may be discovered subsequently.

[2] We may further note here the difference between *bifacial* and *unifacial* flint artifacts. The former are flaked *all over both facies* (or nearly so), while the latter are blades retouched *only along their edges* (though the retouching may have been applied from both faces).

[3] See J. Capart (1905), pp. 139 f.

these depicted symbols continue in later times as clan-ensigns and emblems of deities. In spite of its local character, however, the Early Pre-Dynastic culture of Egypt had fairly wide commercial relations with the outside world. Besides gold from Nubia, copper and malachite from Sinai, wood came from Syria and obsidian and (rarely) lapis lazuli from further East [1].

A real change, however, takes place with the Middle Pre-Dynastic (Gerzean) stage [2]. The flint industry becomes much more refined. To this stage belong (mostly) the fine and famous rippled knives and the so-called "fish-tail" knives [3]. Both these types combine the grinding and the flaking techniques; as they must have been first roughly chipped, then ground to the required shape and then re-flaked anew. This combination may have been, in some way or other, descended from the somewhat similar, though coarser, dual technique which characterized the polished and reflaked axes of the Fayyoum A. The mace-heads of this stage are globular and pear-shaped while those of the Amratian were flat and disc-shaped [4]. Simple blades and scrapers continue to abound, but we have in this stage a new and special type of knives with alternate lateral retouch (*i. e.* worked on the upper surface along one edge and on the lower, flat, one along the other, *e. g.* No. 1 on our Pl. XV). Like the Amratian, however, there is an absence of planes (gouges with plano-convex cross-section) and of axes (an absence which distinguishes it from Armant). But the chief change from Early to Middle Pre-Dynastic is still better marked in pottery. The Black-Topped and the Red-polished wares, which reached their zenith in the Early stage, begin to give way to new types of a different technique. The white cross-lined pattern goes out altogether. Its place is

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[1] See V. G. Childe (1934), p. 73; see also G. Brunton (1937), pp. 83-84.

[2] For a good account of this stage see A. Scharff (1927), pp. 29-38 and (1931), pp. 24-28.

[3] G. Brunton (1937, p. 90) mentions some fish-tail knives which he thinks may perhaps belong to the Amratian. The date of these specimens, however, is not certain. A fairly detailed study of the forked bifacial knives has been made by Massoulard (1936). According to this author (see especially, pp. 146-147 of his article) the type with concave end (*lances à bord supérieur concave*) starts in the Early Pre-Dynastic, but the true fish-tale one (*lances en queue de poisson*) occurs practically only in the Middle Pre-Dynastic.

[4] On this difference in mace-heads see W. M. Flinders Petrie (1920), p. 22. It should be noted, however, that in N. Egypt the pear-shaped type occurs in the Neolithic of Merimde (*vide supra,* footnote 2 on p. 299).

taken by Decorated pots, which—judging from both their shape and their decoration—form imitations of a stone-vase technique. There are also some theriomorphs and spouted vases, which probably represent contact with Syria [1]. Of more interest still are the much discussed Wavy-Handles. Frankfort has put forward the view that these were imported (containing oil) from Syria, while Junker believes that they were made in Egypt [2]. Scharff, on the other hand, thinks that the evolution of this type in Syria and Egypt is not quite the same and that consequently it may represent a common product of both countries [3]. There can, at any rate, be little doubt that the Gerzeans had wide commercial and cultural contacts. The fact that their culture was centred mainly in northern-Middle Egypt, and does not seem to have penetrated towards Nubia, indicates that in all probability they were of northern origin. It is quite likely that their original home-land was in the Delta and its bordering deserts, but of course this point still needs archaeological confirmation.

The Late Pre-Dynastic stage is the one also known as the Semainian. During this stage commercial relations with S. W. Asia (Mesopotamia) were much increased [4], but Scharff thinks that apart from this the so-called Semainian was primarily the result of a fusion of the Amratian and the Gerzean [5]. Indeed, the real importance of this stage is that it was preparatory to the rise of the Dynasties (or the Proto-Dynastic stage (?)). The Delta which, as we have already inferred, seems to have contributed immensely to the development of the earlier (Gerzean) culture, continued to provide an important field of development. Unfortunately, the impracticability of

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[1] The animals represented by these vessels (such as the hippo), however, are distinctly Egyptian. It may be stated, therefore, that although the technique may have been borrowed from Syria, the pattern and its execution were Egyptian.

[2] Compare H. Frankfort (1924), pp. 19 and 104-105 with H. Junker (1928 *a*), pp. 865 ff.

[3] A. Scharff (1927), p. 32. See also reference to this problem of the Wavy-Handles in O. Menghin and M. Amer (1932 *a*), pp. 26-27.

[4] On these relations see H. Frankfort (1924), pp. 118 ff. Also references in G. Childe (1934) pp. 106, 116 and 120-127.

[5] A. Scharff (1927), pp. 38-46. As already pointed out (*vide supra,* footnote 4 on pp. 309-310) this author uses the term Naqadah (Negâde) culture to cover the whole of the Pre-Dynastic phase. His Naqadah I is the equivalent of the Early (or First) Pre-Dynastic or Amratian, and his Naqadah II the equivalent of the rest of Pre-Dynastic times.

any excavations in this mud-coated region makes it impossible to reconstruct a real picture of its cultural evolution. The fact that many of the northern culture elements introduced into Up. Egypt cannot be satisfactorily traced to Asiatic origins may throw indirect light on the part which the Delta played at that time. But the traditions and legends which survived into early historic times leave no doubt as to the importance of this northern region [1]. The various versions of the struggle between Osiris (and Horus), on the one hand, and Seth, on the other, point to the fact that during certain intervals the Delta stood at a higher political (and cultural) level than the South [2]. It is true that these legends do not appear in Egyptian records until much later times (Osirian family not being recorded before the 6th Dynasty); but they almost certainly reflect events that happened before the dawn of history. Indeed mythology at this stage must be relied upon to supplement incomplete archaeological data. In the absence of adequate archaeological material pertaining to the late prehistoric and the protohistoric phases (especially in the Delta and its borders), we feel justified in calling upon legendary accounts to fill in the gap. This may not give us an accurate picture of the story, but at least it helps us visualize the main events of these obscure phases. According to these legends, Osiris represented the God of the Nile (Delta), of Corn and of Vegetative Growth. Seth, on the other hand, was the God of Desert and Destruction, the eternal enemy of the Nile and of vegetational life. Seth killed Osiris, but he was fought by Horus, the posthumous Son of Osiris (and Isis). Seth fled to the South and became the First Lord of Ombos (Naqadah region). On one occasion, the God Geb (of the Great Ennead of Heliopolis) is reported to have settled the differences between Horus the Elder and Seth; "I have given you your portions", He said, "Upper Egypt to Seth,

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[1] When King Narmer conquered Saïs, the Capital of the Delta, he was reported to have captured "100.000 prisoners, 400.000 oxen and 1.422.000 goats". See P. E. Newberry (1923), pp. 183-185. Although these figures may be exaggerated, they seem to indicate that even the North of the Delta (where Saïs lies) was well inhabited by that time. Some authors, like E. von Rosen (1929, pp. 3-20), go as far as to infer, from legendary accounts and also from comparative study of Early Dynastic architecture, that the Dynastic civilization started among "the marsh-dwellers of the Delta".

[2] On some versions of these legends see A. Moret (1927), pp. 60-100.

and L. Egypt to Horus'' [1]. On another occasion He is reputed to have judged that Horus the Child [2] should combine the Red Crown of the North and the White one of the South [3]. This might have corresponded to a moment when the political (and cultural) balance was in favour of the Delta, as indeed may be gleaned from the adoption by the South of certain cultural elements from the North (*e. g.* the cult-ritual of Horus) [4]. But ultimately (perhaps for strategic reasons [5]) the victory was destined to fall to the Upper Egyptians, who became the *historic* Masters of the United Land. Narmer [6] took over the divine rights and duties of the Servants of Horus, who had before inherited those of Horus and Osiris. The historic Kings of Egypt filled in the place of the Gods of the protohistoric phase.

SUMMARY OF NEOLITHIC AND POST-NEOLITHIC CULTURE-COMPLEXES IN EGYPT. THE "MILIEU AND THE CULTURE" AT THE DAWN OF SETTLED CIVILIZATION. INFERENCES AND SPECULATIONS.

If we may now summarize the story of the true Neolithic and the Post-Neolithic culture-complexes and contacts of Egypt, we find that the former (Neolithic) were represented both in the North and in the South. The earliest

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[1] See A. Moret (1927), p. 71.

[2] Horus seems to have had more than one personality.

[3] Moret (1927), p. 94. This may refer to a *Proto-Dynastic* unification of Egypt.

[4] See H. Junker (1933 *a*), pp. 13-18.

[5] We may note here that the Delta had *more abundant* and *varied* resources than Up. Egypt, but was *less coherent* in its environment and its population. In the Delta there were wider cultivable lands and pastures, and more extensive marshes for fishing and hunting. Also commercial contact was easier with outside world. These factors, working together, led to the material and cultural enrichment of the Delta. But the wide dimensions of the land, the abundance of river branches cutting it into divisions, the ever-changing courses of these dividing branches, the unsettled conditions on the semi-desert borders of the Delta to the East and the West and the ever-renewed drift of nomads from both directions have all rendered difficult the realization of a permanent and strong political and administrative unity and cohesion. On the other hand, the narrow slot of the Valley in Upper Egypt was, apparently, poorer in resources, but easier to mold into a military unit.

[6] We need not go here into all the controversy of whether it was Narmer or ʿAha that represented the First King of the United Land. Prior to the *historical* unification of the Land, there was a phase of what may be called as Proto-Dynasties (*vide supra,* footnote 4 on pp. 309-310).

that we know of at present are those of Merimde (Mremdah) and Fayyoum A, and their date may be roughly stated as 5000 B. C. or rather a little earlier (see also Table XVIII below). Perhaps partly synchronous with them in date, though clearly different in culture, is the Tasian of Up. Egypt. As we know them, these cultures are fully developed and show a remarkable degree of technological evolution, especially in the flint of the North and ceramic of Tasa. They have yielded nothing, however, that would link them, even by commercial relations, with cultures outside N. E. Africa. In this respect we may note

TABLE XVIII.

Tentative (relative) Chronology of the Neolithic and Post-Neolithic cultures of Lower, Middle and Up. Egypt. (The Table reads upwards, and the dates given for Early Neolithic are only approximate). (No time-scale is attempted).

APPROX. DATES.	L. EGYPT AND FAYYOUM.	MID. AND UP. EGYPT.
3300 or 3200 B. C....	1st Dynasty.	1st Dynasty.
	Maʿadi.	Semainian, Gerzean, Amratian } and Armant-Naqadah-Nagʿ Hammadi facies.
	Fayyoum B.	Badarian.
5200 or 5000 B. C. (?).	Fayyoum A and Merimde.	Tasian.

that practically speaking, the north-eastern approach to Egypt (*i. e.* S. W. Asia) has so far yielded no ''Neolithic'' *sensu stricto;* and that the chance for the finding of any really abundant traces of such a culture in the Syrian-Palestinian side of the Crescent does not seem to be very bright [1]. Nor has

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[1] It is not impossible, however, that other parts of S. W. Asia, such as Arabia or the Irano-Taurusian Plateau and its Mesopotamian border, may yet yield such purely Neolithic cultures

the western approach (the Sahara and N. W. Africa) yielded any evidence of connection with these early Egyptian cultures. The so-called Early Neolithic of the Sahara and N. W. Africa is largely made up of a mixture of Neolithic and Final Palaeolithic industries; and it appears that many of the former elements (Neolithic) were largely introduced from without [1] and were simply imposed upon a surviving Final Palaeolithic. Other clear connections between Egypt and the Sahara belong to the Fayyoum B and the Pre-Dynastic phases. As these latter cultures are deeply rooted in Egypt and are only sporadically represented in the Sahara, it is very probable that their connections with other N. African cultures may represent a cultural infiltration towards the West [2]. And finally the southern approach (Nubia) seems to have been affected by an early culture-diffusion (which also covered the Sahara) from further South (?), as represented by the rock-drawings; but this diffusion appears to have had nothing to do with the *true* Neolithic. Indeed, apart from the S. E. Desert of Egypt (which is still entirely unknown), the balance of evidence is in favour of regarding Nubia as having largely served as a "recess", where Upper Egyptian culture elements were driven under pressure from further North. There, they survived after their suppression in Egypt proper by new and evolving cultures.

The oldest Chalcolithic industry thus far discovered in Egypt is that of Badari. It seems to have had certain connections with the Fayyoum A of the North, but, in all its essentials, it was distinctly Upper Egyptian. It was closely followed by the Pre-Dynastic phase proper, which started with the Early or Amratian culture. This latter inherited a good deal from the Badarian, and its domain was chiefly South of Badari. At a later stage, it seems to have been pushed southwards into Nubia, and was superseded (though only gradually) by the Middle or Second Pre-Dynastic (Gerzean) group, which represented a new culture phase in Mid. and Up. Egypt. There can be little

in the future. All indications (such as surface finds, etc.), however, seem to point out that should such cultures be found, they would be of a different nature from those of the Neolithic of Egypt.

[1] Though from where, it is not fully known as yet.

[2] Though it is not impossible that the Fayyoum B and other cultures of the Nile Valley itself (especially Gerzean?) may have been affected by some Libyan (and perhaps other Saharan?) elements.

doubt that it had originally come from the North; and it is quite likely that it may have been largely evolved in the Delta or its borders. It had wide culture contacts and certain similarities with Syrian cultures, though opinions differ as to the extent to which these similarities represented foreign elements which were imposed upon Egyptian culture. After the Gerzean, comparatively few innovations took place. Commercial relations with S. W. Asia continued and flourished, but the last Pre-Dynastic (Semainian) stage was largely the result of a more thorough blending of pre-existing cultural elements. It served as a formative stage which paved the way for the rise of the Dynasties.

Recent excavations and discoveries have thrown useful light on the complexity of culture in Egypt during late Neolithic and Chalcolithic times. We have already seen that in the Fayyoum Depression a microlithic facies survived well into the B stage (which was probably contemporaneous with the early Chalcolithic elsewhere in the Valley). This microlithic facies was largely derived from the local Final Palaeolithic of N. E. Africa (and almost certainly not from the Capsian, as is generally surmised); but it seems to have had certain connections with the S. Sahara (Ounan) and S. Libya (*via* Khargah). We have also seen that in so far as the so-called "Pre-Dynastic" phase is concerned, the succession of cultures in Egypt may ultimately prove to have been much more complicated than hitherto assumed [1]. It is probable that besides the successive culture waves which spread along the valley from the North (Delta and its borders) into Up. Egypt, this latter region was producing a facies of its own, which was especially characterizcd by its flint technique. In spite

[1] It should be noted here that the apparent simplicity in the culture sequence of Pre-Dynastic Egypt as worked out by Petrie is due to the fact that it was almost entirely based on material from graves in "cemeteries". The new complications have come to light as a result of excavations in "settlements" which offer a very valuable check on "cemetery material". The remains recovered from the graves of the richer minority of a human group (as represented in a cemetery) are usually out of proportion to those yielded by the graves of the poorer majority. The former may include far too many of the tradable objects which mask the local facies of culture. Also in spite of the fact that objects of everyday use and actually utilized articles are often found amongst grave offerings, there is sometimes the danger that a grave assemblage might represent life "as it should be" and not quite "as it is in reality". A much more accurate idea of the *genre de vie* of a human group can be obtained through a thorough and careful investigation of a "settlement" of its living members.

of similarities in the pottery, the culture of the region of Armant-Naqadah-Nag'Hammadi cannot be satisfactorily fitted within the classic sequence of Amratian, Gerzean and Semainian [1]. Regional factors of differentiation must have been at work during this phase when the grouping of the society in the Nile Valley was still largely on a tribal (and local) basis [2]. The successive waves of culture invasion and infiltration from the North reached well into the heart of Upper Egypt, but they never succeeded in entirely ousting older elements. The Northern contribution was chiefly manifested in the form of new types of pottery as well as certain classes of flint industry (especially those which combine the polishing and reflaking techniques?); but Upper Egypt (or part of it) did not cease to maintain and develop its own tradition, especially in certain highly specialized classes of flint tools. It was not really until the Late Pre-Dynastic stage that the ever-increasing movements of commercial and cultural contacts (and the fact that the tribes were more and more forced, or attracted, to descend and settle in the valley itself instead of its borders), have gradually brought about a wider and wider unity. At first local Chiefs were responsible for the irrigation schemes and the protection against the floods, but the need for wider collective effort pressed more and more. There were intervals when the Delta and Upper Egypt formed two large and more or less coherent units (each with a special crown or symbol of unity) fighting each other for supremacy. These were crucial moments in Egyptian protohistory, but our knowledge about them is based more on legendary accounts than on archaeological records. Both Delta and Upper Egypt made their contribution towards the cultural and political unification, but the balance was perhaps slightly in favour of the former as the main sub-region of cultural diffusion. Then came the moment, when, for some reason or other (perhaps strategic) the Lords of the South (who originally borrowed

[1] This we have largely based on the comparative study of the flint industries. For the relative value of flint groups and of pottery and other classes of remains *vide supra,* beginning of present Section; also S. A. Huzayyin (1937), pp. 192-193.

[2] This applies to both N. and S. Egypt. We may note, for example, that the Gerzean was not the only facies in N. Middle Egypt and the borders of the Delta. Ma'adi, which must have largely co-existed with the Gerzean and part of the so-called Semainian, maintained a local facies of its own (perhaps more clearly affected by commercial contact with Syria-Palestine ?).

a good deal of their culture from the North) were able to achieve the final (*historic*) Unity of the Land under their control. A crucial phase was nearing its end, and history was well on the way [1].

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But our conclusions seem to be leading into a *cul-de-sac*. We have summarized the culture complexes and contacts of Egypt during the Neolithic and the Chalcolithic; but apart from indicating that the early Neolithic cultures of Egypt could not have been derived from any of the industries *thus far known* in neighbouring areas, we have not thrown any direct light upon the question of the origin of these cultures. Some of the earliest groups that we know of, such as that of Merimde, lived in large villages, enjoyed a relatively high standard of material culture, and had a comparatively complex social and religious organization. This must have implied a fairly prolonged phase of evolution, whose remains are still entirely unknown. It is generally thought that the final desiccation in late Upper and Final Palaeolithic times may have forced the wandering groups of hunters (as well as the game itself) to the watering-places (such as river sides and oases), and that this was probably connected with the beginnings of both agriculture and domestication. This may be a reasonable speculation; but, judging from the climatic and the archaeological data, it does not seem to give a sufficiently accurate picture of the story. We have already mentioned that the Neolithic was marked by an increase in precipitation in Saharan latitudes, and it may be argued with more force that it was the relaxing of the climatic crisis (during the so-called "Neolithic" wet phase from about 5500 B. C. to *circ.* 2500 B. C., with a later, less marked, oscillation) rather than its intensification (before that phase) that led to the fostering of new cultures and the facilitating of contacts between widely separated groups in otherwise arid regions. Furthermore, it should be noted

[1] It may be noted that in our present synoptic study of the Neolithic and Post-Neolithic cultures of Egypt, we have avoided entering into details relating to the racial types belonging to each of the successive cultures. Skeletal material from these phases is available, and in several cases, it has been reported upon; but comparative studies with material from neighbouring regions are still a *desideratum*. We therefore thought it safer, in the present state of our knowledge, to content ourselves with a primarily archaeological survey.

that the technological study of the earliest Neolithic cultures of Egypt has shown that they had no connection whatever with the Final Palaeolithic facies. All that there is in the way of contact between the two cultures is that certain types of microliths survived and became, later on, mixed, not with the true Neolithic of the country (Merimde and Fayyoum A) but with later cultures. A glance at our Plates (XI and) XII may be sufficient to show that we have in the late Middle, Upper and Final Palaeolithic of parts of Egypt a technological sequence which starts with a late Levalloisian industry, passes through a stage of steep trimming and mutilation of implements, and finishes with a microlithic facies. This is quite different from the new and independent sequence illustrated on Plates XIV and XV (Neolithic and Post-Neolithic). The elaborate and massive bifacial implements of the Neolithic cannot have been directly derived by any simple process of technological evolution from the microliths of the Final Palaeolithic. We are therefore forced to the conclusion that although the Neolithic folk of Egypt must have been descended from some late Upper Palaeolithic ancestry, the conditions under which they developed their new culture were so different from those of their ancestors, that adaptation between *man* and *milieu* had to follow entirely new lines.

But where is the new *milieu* to be looked for? It is evident that, unless we derive Egyptian Neolithic from some *still unknown* foreign ancestry, the only alternative that we are left with is the Nile Valley itself. There is one apparently serious objection to this speculation, and that is that the Valley and its Delta were too marshy to be propitious to such a cultural evolution. In answer to this, however, we may recall the physiographic evidences recently brought to light in the Nile Valley [1]. According to recent investigations the Upper Palaeolithic was marked not only by progressive dryness but also by a process of "degradation" or lowering in the bed of the river in L. Egypt [2]. The

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[1] On these *vide supra,* Appendix to Part I.

[2] This is shown particularly by the cessation of the flowing of the Nile into the Fayyoum Depression and the severing of connection between the two. See Caton-Thompson and Gardner (1929), pp. 32-36 and Gardner (1929 *a*), pp. 371-383 (particularly graphs). Also Sandford and Arkell (1929) who mention that during this phase there was even an outflow from the Fayyoum Lake into the Nile which was lowering its bed. Also on various processes of degradation and aggradation in Nile Valley see more recent work of Sandford and Arkell (1933).

waters of the drying river were no longer able to inundate its sides, and they became more and more confined to a limited bed which they cut down [1]. This meant that the flood-plain and Delta of the river were no longer reached by inundations and that lateral and deltaïc marshes were gradually drained into the river. In other words, the bottom of the Valley and its Delta must have been rendered fairly suitable for hunting, fishing and permanent or semi-permanent settlement. But the hunt in the Valley was different from that on the drying Plateau, as the game was made up of hippos, elephants, boars, etc., instead of gazelles, antelopes or ostriches. Hence the need for more advanced types of flint implements than those of the late Upper and early Final Palaeolithic. Of course, for such material as flint the new Valley dwellers had to depend entirely upon the adjoining deserts. But basketry and reed and mat work could all be made from local material. Also pottery, which was unknown in the Up. Palaeolithic of the Saharo-Arabian area generally (though it was known elsewhere) could be readily made from local mud. The seeds for cultivation may first have been obtained from the adjoining plateau (probably barley locally and emmer either locally or from the Syrian side?), but the annual rhythm of floods and low-waters (the latter taking place during the growth season of such cereals as barley and wheat) must have ultimately fostered the beginning (or the development) of some form of agriculture (at least in some of the favourable spots such as the edge of the flood-plain) [2].

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[1] It may be useful here to recall the two main admitted factors which govern the processes of degradation and aggradation in a river system; namely the change in the supply of water and material (which, if increased would bring inundations and rise in bed, and *vice versa*) and the oscillations in base- or sea-level (which if lowered would increase the degrading power of the river and if raised would help first the formation of marshes and then their silting up by aggradation). We need not, however, go into all the other details concerning differences and lagging in time of degradation and aggradation between L. and Mid. parts of streams (such as the differences between the Delta and Nubia).

[2] All sorts of vegetable growth would cover the edges of the Valley and Delta immediately after the subsidence of the floods, and fishing and hunting groups may have marked and guarded them till the reaping season was due. This is admittedly not cultivation in the strict sense, but it represents a spontaneous and evolutionary progress towards cultivation proper. The suggestion appeals more to reason because it averts the necessity of a sudden "invention" of agriculture as may be assumed by most current theories on the subject. In the same way we prefer to think

Why is it then that all the cultures that have thus far been discovered on the outer "edges" of the Valley and Delta belong either to the fully evolved Neolithic stage or to the Early Chalcolithic? An indirect answer may again be found in the physiographic data. We know that the so-called "Neolithic" wet phase corresponded to the Climatic Optimum of northern latitudes [1]. This was a warm phase during which ice-caps were very much reduced and sea-level was appreciably raised (by melting ice flowing to it). The rise of the base-level (mean level of the Mediterranean) put a check on the degradation of the Nile in L. Egypt, and it also decreased the draining power of the lowermost course of the river. Increased precipitation on the Abyssinian Plateau led to high inundations and development of marshes on the sides and in the delta of the river. It took some time for these marshes to get silted up through the ordinary process of aggradation. Can we draw the conclusion from all this that although the bottom of the Valley and certain parts of the Delta may have been suited for settlement during the transitional stage (whose remains are now under the mud) between the Up. (and Final) Palaeolithic and the Early Neolithic, they became less favourable for such settlement during the true Neolithic (Merimde, etc.) and the early Chalcolithic? If this be accepted, it would mean that after having established themselves (and evolved the first elements of the new culture) close to the river-bed and on the Delta, the hunting, fishing, cultivating and breeding groups were forced (from Early or Proto-Neolithic times onwards) to shift their settlements to the outer edges of the flood-plain which was again becoming marshy near the river. It should be made clear, however, that the unfavourable conditions in the bottom of the Valley and its Delta were not destined to last. The gradual decrease in the rainfall on Abyssinia (descending maxima of the wet phase in E. Africa and Abyssinia) has gradually led to decrease in inundations in Egypt. Consequently the waters of the L. Nile could not flood its high and aggraded outer banks. In fact, there was a second phase of degradation (in the L. reaches of the river), which continued during Neolithic and Early Chalcolithic times.

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that most of domesticated animals may have been first "kept in captivity" before the idea of domestication proper was evolved. However, this is a digression.

[1] *Vide supra,* Part I, pp. 142-143; also S. A. Huzayyin (1936), pp. 19-22.

But judging from archaeological data the process of degradation (and draining of marshes) does not seem to have rendered the bottom of the valley (and the immediate neighbourhood of the stream) habitable until late-Early and Middle Pre-Dynastic times. From that time onwards people descended (or rather re-descended) into the Delta and flood-plain and established themselves again nearer the course of the river [1]. We may perhaps describe this new phase as the "re-settlement" of the valley floor and Delta—the "first settlement" being that which accompanied the degradation at the close of the Palaeolithic [2]. Having settled on the lower ground the tribal units became identified with the small regions which they occupied. Thus the country became divided into a number of small regions (*"pays"*) instead of a number of tribes. The ever-increasing pressure on the river side, and the common benefits and dangers that such a movement entailed have all contributed towards the welding of tribal groupings or rather regional units into larger ones. At a certain stage L. and Up. Egypt constituted two large political provinces which fought each other for supremacy, until *final* victory fell to the Masters of Upper Egypt. With the *historic* unification of the White and Red Crowns of the South and the North, one of the most crucial phases in the story of Egyptian Society came to its logical conclusion, and the definite political unity of the Land gave final expression to the more essential geographical—and to a large extent cultural—unity. Thus a movement of intensive localization and specialization of culture which started in the Pre-Neolithic (and Proto-Neolithic) was ultimately destined to bear its fruit in historic times.

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[1] The prehistoric settlements and cemeteries of the new phase occur nearer the present flood-plain than they did in earlier stages. Also mention of new changes in utilization of valley-bottom in Middle Pre-Dynastic times in G. Brunton (1928), p. 48. We may further note that the depiction of clan ensigns on decorated pots from the Gerzean phase may denote that the totemic clans, vaguely discerned in the Amration, became firmly established in their regions (seats) in Middle Pre-Dynastic times. See reference in G. Childe (1934), pp. 94-95.

[2] In a previous publication (S. A. Huzayyin, 1939, pp. 253-260) the present writer has suggested a slightly different sequence of events (from the one presented here) for the physiographic cycles of the L. Nile Valley in their relation to land utilization in late prehistoric times. The present account has been modified in the light of more up-to-date discoveries in the region of Turah and Ma'adi, S. of Cairo (*vide supra,* Appendix to Part I, footnote 2 on p. 153).

GENERAL SUMMARY AND CONCLUSIONS

GENERAL SUMMARY AND CONCLUSIONS.

A SYNOPSIS OF CLIMATIC CORRELATIONS AND CULTURE-SEQUENCE IN THE OLD WORLD AND EGYPT (IN QUATERNARY AND RECENT TIMES).

I. CLIMATIC RECORD AND CORRELATIONS.

The present work falls into two Parts : Part I, the climate and physiography of the Quaternary (and Recent) ; and Part II, the technological sequence and the geographical distribution of cultures. In the first Part we attempted a general survey of the climatic record of the Diluvium (and later) as deduced from the physiographic and bio-geographical data in various parts of the Old World. It has been found advisable in the treatment to proceed backwards, *i. e.* starting with the protohistoric phase and finishing with the close of the Pliocene. This has admittedly been a hazardous method—like walking backwards!—, but it provided us with a more secure starting point. It was also found that in order to gain a clear insight into the story of past climates over the Saharo-Arabian Belt—the area with which we were particularly concerned here—it was necessary to attempt a broad survey of conditions along other climatic zones. It was clear from the outset that the changes in climate during Diluvial times were of more than local significance, and that they must therefore be treated—at least in their general outlines—on a wide basis. For this purpose, the western half of the Old World was divided into three main Climatic Belts : the Northern, the Middle and the Equatorial. Each of these Belts was in turn divided into smaller regions, the evidence for each of which was surveyed and weighed quite independently from that for the others. Zonal correlations along each of these Belts were then attempted. The results of these may be summarized as follows :

Along the N. Belt (including N. Europe and the Alpine chains) the following sequence was establised (beginning with the most recent) : (1) a Post-Glacial

warm phase (the Climatic Optimum of N. W. Europe, which was then warmer than it is at present); (2) a Late-Glacial phase of gradual melting of ice with stadia; still cold; (3) the last Glacial (Weichsel—with Warthe?—, equivalent of Würm); (4) the last Interglacial with three-fold division : warm (warmer than the present), cool and relatively warm again; (5) the last Glacial but-one (Saale—with Warthe?—or Riss) which was most extensive on the European Plain; (6) the first Interglacial which was exceptionally long and rather warm (and uninterrupted); (7) the first Glacial (Elster or Mindel) which was especially extensive on the mountain-blocks; and (8) the Pre-Glacial phase which included the Günz Glacial of parts of the Alps and a corresponding phase of *''refroidissement''* in the North.

Along the Middle Belt (Saharan latitudes) a somewhat different sequence was established : (1) a *so-called* ''Neolithic'' fairly wet phase (*roughly* Middle of 6th mill. to Middle of 3rd mill. B. C.; but with a later oscillation) which was apparently also warmer than the present; (2) a Post-Pluvial phase of increasing aridity which reached its maximum in late Up. Palaeolithic times; (3) the 2nd Pluvial with two or three sub-maxima (the interval between the first and the second sub-maxima being less marked than that between the second and the third); (4) the only true Interpluvial recorded which was rather short but very dry (and was presumably also characterized by wide crust movements and volcanic activity); (5) the 1st Pluvial which was very long (constituting the main feature of the Diluvium) and presumably also very warm towards its middle part; and (6) prior to this phase there was a preparatory phase marked by gradual on-coming of pluvial conditions.

The sequence *along the Equatorial Belt* was similar in its general outline to that of Middle latitudes.

Then came the question of the general correlations of these changes. Here we were confronted with the paramount difficulty of finding an explanation for the climatic changes of the Diluvium. Theories concerning this point vary widely, and none of them is sufficient. Perhaps the most reasonable solution—if any such solution could be attained—would be in a combination of more than one theory. We find, however, that it serves no practical purpose to pick and choose between these various theories; and it has therefore been decided in the present treatment to leave aside the question

of the ''primary causes'' (astronomical, geophysical, etc.) of climatic changes, as the problem cannot be satisfactorily solved in the present state of our knowledge. On the other hand, the problem of the ''secondary factors'' involved in such changes could be tackled much more profitably. Such factors are usually connected with vast meteorological changes which take place during phases of abnormal disturbances in the general climatic régime of the main belts of the globe. During a phase of a glacial advance in N. latitudes the pressure gradients over the globe became steeper. Westerlies which usually pass along the latitudes of the European Plain were diverted southwards, and the Mediterranean and the N. Sahara received more rainfall. Also on the S. edge of the Sahara there would be more frequent meeting of the ''cold air fronts'' (advancing from the North) and the ''warm fronts'' of the semi-monsoons. Some of the cold fronts would reach as far as the Equatorial Belt where precipitation would become increased. A glacial phase in the North may therefore be safely taken to correspond to a pluvial one in Mid. and Lower latitudes. An interglacial phase, on the other hand, presents a much more complicated case. We have seen that in Europe intervals between Glacials were either warmer or cooler than the present. During an exceptionally warm Interglacial (or part of an Interglacial) one would expect a general acceleration in the wind system over the globe (as a result of the rising temperature). Remote centres of the Continents would be reached by air currents penetrating from the sea. There would be an increase in evaporation which must ultimately take the form of precipitation. This would be particularly the case if the rise in the temperature of the air were accompanied by a rise in that of the waters of the seas (as may be testified *e. g.* by the spread of warm malacological fauna northwards and southwards from the Equator). Also during such a phase storminess would be increased and the tracks along which storms proceeded would become much less defined than under present conditions. In regions like the interior of the Sahara, ''stray'' depression-storms from the Mediterranean would have a beneficial effect upon regions which are now almost entirely dry. Along the Sub-Equatorial Belt the monsoons or semi-monsoons would attain exceptional power. Convectional rainfall would also increase, and the same amount of water could be dropped as rain for a larger number of times (than at present)

during a given period. We therefore see that a warm Interglacial would also correspond to increased liquid precipitation over most parts of the world (especially Mid. and L. latitudes). On the other hand, a cool (slightly colder than at present) Interglacial (or part of Interglacial) would be accompanied by conditions different from those of either a Glacial proper or a warm Interglacial. There would be general relaxing in the aerial circulation over the globe as a whole. Conditions over N. latitudes would not be cold enough (especially in summer season) to allow the development of snow-fields and ice-sheets; and there would therefore be little or no diversion of the Westerlies southwards. In Lower latitudes such winds as the monsoons and semi-monsoons would be weaker and seasonal rainfall much reduced. Convectional rainfall over the Equatorial Belt would also become less abundant. This is the type of phase during which one would expect interpluvial conditions over Middle and Equatorial latitudes.

With these points in mind, we have attempted at the close of Part I a general correlation of climatic changes [1]. The conclusions arrived at there are not in full agreement with those suggested by various workers for certain parts of the Old World. Whereas it is usually assumed that Glacials and Interglacials corresponded in time with Pluvials and Interpluvials respectively, we find that the question of correspondence was more complicated than that. It is true that a Glacial in the North must (in all probability) have corresponded with a Pluvial in more southerly latitudes, but an Interglacial did not always correspond with an Interpluvial. It is hoped that this cardinal point in the question of correlations may help to account for the obvious discrepancy between the numbers of Glacials and Pluvials in Northern and in Middle and Equatorial (taken together) latitudes respectively.

The summary of the suggested correlations is given in Table XII. The following points may be repeated here : 1) the Climatic Optimum of the North corresponded to the so-called ''Neolithic'' wet phase of Saharan and Equatorial latitudes. This was a phase of relative rise in the temperature

[1] These conclusions have already been published, in summary form, by the present writer (see S. A. Huzayyin, in *man* 1936, pp. 19-22 and 88). Nothing has come to light more recently that would necessitate a radical alteration in these conclusions.

of the air and of the waters of the seas. 2) The Weichsel Glacial (or Würm I and II) together with its retreat stages (Late-Glacial, especially Bühl in the Alps) corresponded to the 2nd Pluvial. 3) The middle (cool) part of the Saale-Weichsel (or Riss-Würm) Interglacial corresponded to the only true Interpluvial recorded (short one; but quite effective). The later and (more particularly) the earlier parts of the same Interglacial were relatively warm and may have corresponded to moderately pluvial conditions in more southerly latitudes. 4) The first two Glacials (Elster and Saale or Mindel and Riss), together with the intervening Interglacial corresponded to the first and major Pluvial of Middle and Equatorial latitudes. The evidence available is in support of the Elster-Saale (or Mindel-Riss) Interglacial having been marked by a rise in the temperatures of the air and the seas. 5) And finally, the Pre-Glacial phase of Europe corresponded to the preparatory Pre-Pluvial phase of Mid. and L. latitudes.

With the help of these correlations and by studying their bearing on the question of changes in sea-level (a glacial phase corresponding to a lowering of sea-level by the storing of water in the form of ice-sheets and caps, and *vice versa*), we have attempted (Appendix A to Part I) to reconstruct the story of recent physiographic changes in the L. Nile Valley. These are of special importance as they help to fix the place of the culture phases of Egypt (with which we are specially concerned here) in the climatic succession of the Diluvium and Recent.

II. CULTURE SEQUENCE, DISTRIBUTIONS AND INTER-RELATIONS IN THE OLD WORLD. PLACE OF SAHARAN AREA AND EGYPT.

The Second Part of the present work deals with the archaeological sequence of cultures and their geographical setting and distributions. For obvious reasons it was impossible to follow the same line of treatment as we did with the climatic changes, *i. e.* starting with protohistoric times and proceeding backwards. This would have meant that we should have had to hold the ends of the threads practically all over the world—an impossible task for a work of the present nature. We have therefore started with the Early Palaeolithic and finished with the dawn of history. In Section 1 (dealing

with the L. and Mid. Palaeolithic) we have found that there were two main culture areas : one characterized by a *coup-de-poing* and flake culture in a great part of the Eurafrasian [1] land-mass, and another with a purely flake industry in the Eurasiatic Steppe. In weighing the evidences derived from the available data it became clear that we should not speak of ''home-lands'', but rather of ''kernel-zones'' of the various cultures. Although it is admitted that there must have been a single ''home-land'' or ''cradle'' in which man (or the *human species*) was first evolved long before the Stone Age, the matter is different when we deal with the *human cultures* in the Palaeolithic. Apart from the fact that our limited knowledge of the Pre-Palaeolithic (Eolithic?) phase makes it extremely unwise to speak of original ''home-lands'' of cultures, it is not improbable that the lowest industries of the Palaeolithic started in more than one centre and that it was through prolonged culture contacts that they attained the homogeneous, though complex, technological character that we know. The ''kernel-zones'' discussed in Section 1 may have therefore played the *dual part of assimilation and diffusion*. The main conclusion we arrived at is that the Saharan (or Saharo-Arabian) Area (including N. Africa and N. Arabia) must have represented the chief kernel-zone of L. Palaeolithic of the Old World. In the Mid. Palaeolithic, on the other hand, the Eurasiatic Steppe began to play a very conspicuous part. It is quite probable that the main elements in Mousterian technique had their origins there and were spread into the Eurafrasian zone (of the *coup-de-poing* and flake technique). It is interesting, however, that so far as Egypt is concerned, some of the evolved and progressive forms of the L. Palaeolithic cultures persisted into the Middle Palaeolithic which was not affected by the Mousterian. Already at this early stage this corner of Africa had an intensely local facies (of flakes) which, having been originally introduced from a still unknown provenance, became steadily differentiated from facies in adjoining areas. It may be safely concluded that the Nile Valley did not form one of the main corridors along which the Mousterian spread itself into various parts of Eurafrasia.

Section II of Part II deals with the Up. and Final stages of the Palaeolithic.

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[1] A convenient term to cover the land-mass of Europe, Africa and Asia.

Here we have noted that the Eurasiatic Steppe-land zone, active in connection with earlier flake-cultures, contributed predominantly to the evolution of the Up. Palaeolithic. But the African zone (especially the Sahara) also played its part though on a more local scale. The *localization* of culture during this phase became much more pronounced than before. A technological study of the cultures has revealed that we have during this phase a large number of facies and sub-facies which cannot always be traced to the same ancestry. *Specialization* on a regional scale and to meet varying conditions became more intense than ever before. It is true that a more or less common Aurignacian culture can be traced in Europe, and S. W. Asia (and perhaps as far South as E. Africa?), but it is probable that it spread in at least two distinct waves (representing the L. and the Mid. Aurignacian—the Up. Aurignacian being essentially a development of the facies of the Lower). The Capsian of Spain and parts of N. W. Africa is related to the L. (and Up.) Aurignacian, though it partly also represented a regional development. It is generally held that it started in Africa, hence it spread northwards; but we have adduced evidence to suggest that the movement was probably in the opposite direction (*i.e.* that the culture was not of African origin). Another culture of N. Africa (and the Sahara) was that of the Late or developed Atirian, which was evolved locally from the Early Atirian (itself a local and specialized facies of the Mousterian). But it is also interesting to note that, as in the case of the Mid. Palaeolithic, the N. E. corner of Africa was able to develop a special Up. Palaeolithic facies of its own (the Sabylian and allied forms). This was evolved essentially from a local facies of late (leading into what we termed as Diminutive) Levallois, and it had special features which differentiated it from both the Aurignacian and the Capsian (the two blade industries of the Up. Palaeolithic of Palestine and N. W. Africa). This was therefore another phase of *intensive specialization* in the L. Nile Valley (which did not serve as a corridor for migrations). In this respect, it is necessary to remember that although climatic conditions were becoming drier and drier towards the closing stages of the Up. Palaeolithic, the climate was still fairly favourable during the formative stages of the Up. Palaeolithic of Egypt. During those crucial stages therefore, the Nile did not attract expanding groups, and its industries were allowed to develop almost unaffected by external influences.

The Final Palaeolithic was marked by desiccation in most parts of the Old World. It is generally assumed that the desiccation was accompanied by large-scale migrations (especially from the Sahara) which led to the spreading of the so-called microlithic cultures. We have seen, however, that a detailed and comparative technological examination of the various microlithic facies and sub-facies would probably show that they did not belong to one and the same technique and that they probably had more than one line of descent. Even if we take such a small country as Egypt, we find that the microlithic technique did not develop homogeneously all over the land. Specialization on a local scale must also have been at work during this phase; and in spite of the existence of such a river as the Nile (which might have fostered contact), there was relatively little assimilation of the partly degenerate culture groups of the Final Palaeolithic. We prefer, therefore, to think that, far from leading to large-scale dispersals and culture contacts, the final desiccation of climate (especially over the Saharo-Arabian Belt) in late Up. and Final Palaeolithic times was followed by intense localization of culture-groups in semi-secluded areas. In certain favourable spots this localization was marked by a high degree of progressive specialization along new lines [which *may* have been connected, in some way or another, with the rise of Pre-Neolithic and Proto-Neolithic cultures in Egypt (?), though the nature of these latter is not sufficiently known as yet], while in other less favourable areas it led rather to degeneration.

But we have seen in the last Section (and in Part I) of the work that the desiccation soon gave way to a renewal of wetter conditions. The relaxation of the climatic crisis was followed by extensive culture contacts between various groups. It is with this that the immense enrichment and diffusion of Neolithic and Post-Neolithic cultures are to be connected. Unfortunately, it was not possible to follow in this Section the same general (and world-wide) treatment as we did in previous Sections, as such a treatment would have required a special work on its own. It was therefore decided to limit the study of the Neolithic and Post-Neolithic phases to Egypt and its approaches. As a result of this study, it was found that, *as far as our present knowledge goes,* the true Neolithic of Egypt had no apparent connections with any cultures outside that country. We are left with the possibility that, unless it was

introduced from some still undiscovered foreign provenance, the Egyptian Neolithic was autochthonous in all its essential elements. Interestingly enough, however, this latter speculation is not in disharmony with the physiographic evidence, according to which there was a phase of river degradation (and draining of swamps) during late Up. Palaeolithic and Pre-Neolithic times which rendered the Delta and the bottom of the Valley suitable for settlement. Indeed, we find good reason to believe that if the remains of any Pre-Neolithic cultures were to be discovered at all, they would be found well under the heavy coat of river alluvium [1]. Then during the phase of the Proto-Neolithic and the true Neolithic (as we know it at present) the bottom of the Valley and its Delta seem to have become again unsuited for settlement. Higher inundations owing to increased precipitation on Abyssinia and perhaps also to rise in base-level (during the equivalent of the warm Climatic Optimum, when ice sheets were very much reduced and their water drained into the sea) have apparently forced the human groups to move to the outward edges of the flood plain. This state of affairs lasted right through Neolithic (and Early Chalcolithic) times. But gradually the discharge of the river was falling down (descending maxima of Neol. wet phase) and the marshes were gradually drained away. This made possible the "re-settlement" (or at least the "re-utilization") in a more permanent way of the valley floor and the immediate neighbourhood of the river. The change took place (gradually) some time during the Pre-Dynastic phase, when the tribes appear to have become more and more attached to the soil of their tribal domains. *Man* and *Milieu* have thus become more attached to each other. During this phase (Pre-Dynastic) the culture contacts between Egypt and the adjoining regions were much increased. Although the contacts with the W. and S. approaches of Egypt were, for the most part, marked by

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[1] This passage was first drafted early in 1935. In the late winter of 1940 the present writer has discovered at Turah (S. of Cairo) and under a thick coating of Nile alluvium (several metres in places) an atypical (microlithic-like) industry, which *may* fill in *part* of the lacuna mentioned here. *Vide supra,* the Appendix to part I. The excavations (which constitute a branch of Prof. M. Amer's excavations for the Fuad I University at Ma'adi) have not been completed as yet, and the industry still awaits study and classification. The remarks noted here must, therefore, be regarded as entirely provisional.

a culture diffusion or infiltration from the Egyptian side (into the Sahara and Nubia respectively), the connections with the Syrio-Palestinian side were in many respects of a reciprocal nature. It should be made clear, on the other hand, that, however strong may have been the foreign (S. W. Asiatic) influences upon the Pre-Dynastic (Middle and Later) cultures of Egypt, these latter have retained their own Egyptian character as based upon the Neolithic and Early Chalcolithic industries and culture groupings in the L. Nile Valley. The foreign contacts of Chalcolithic and protohistoric Egypt have led to the *enrichment* but not the *overwhelming* of its culture. The ever-increasing pressure on the river-side, and the common benefits (irrigation) and dangers (floods) that such a movement (re-settlement of bottom of Valley and attachment to soil) entailed have all contributed towards the welding of tribal groupings into larger and more settled units. Thus the "geographical region" or "*pays*" has gradually taken the place of the "tribal group". At a certain stage, L. and Up. Egypt constituted two large political provinces which fought each other for supremacy. From a cultural point of view, the balance was slightly in favour of the Delta; but, for some reason or other (perhaps strategic), the *final* victory fell to the Masters of Up. Egypt. With the *historic* unification of the White and Red Crowns of the South and the North, one of the most crucial phases in the story of Egyptian society came to its logical conclusion, and the political unity of the Land gave final expression to the more essential geographical—and to a large extent cultural—unity. At this juncture we pass from late prehistoric and protohistoric times to plain history, and here we bid leave to the story.

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The following list of references can in no way claim to be a complete bibliography. It would need a special work on its own to compile a full bibliography on the geological and archaeological sides of the subject-matter of the present synthesis. Only references of direct importance or bearing upon our work have therefore been included here. It was also not found necessary (*for our present working purposes*) to include all the works based upon evidence which has been rendered largely obsolete and out of date through more recent discoveries and investigations. In order to save space in the footnotes accompanying our text, only names of authors and years of publication have been given. A key to the full titles and references of publication may be found in the following alphabetical list, which is preceded by the abbreviations (of Periodicals, etc.) adopted in it. Publications belonging to the same author have been arranged in chronological order, first those which he wrote alone (or for which he took entire responsibility) and then those in which he cooperated (*i. e.* shared *collective* responsibility) with others. It was not found advisable, however, to classify our references into subject-groups relating *e.g.* to Quaternary-Physiography, Palaeo-Climatology, Prehistoric Archaeology, etc. Apart from leading to undue repetition (as most of our references would have had to be mentioned under more than one heading), this would have rendered more difficult the task of the reader in tracing the references he requires. Some idea about the classification of our bibliographical material, however, may be indirectly obtained from the Index (at end), in which names of authors and pages on which they have been mentioned in various parts of our text are indicated.

ABBREVIATIONS (PERIODICALS, ETC.).

Anc. Eg. = *Ancient Egypt* (British School of Archaeology in Egypt), London.
Ann. de Géogr. = *Annales de Géographie*, Paris.
A. S. A. Ég. = *Annales du Service des Antiquités de l'Égypte*, Le Caire.

Ann. Arch. and Anthrop. = *Annals of Archaeology and Anthropology*, University of Liverpool.
Ann. S. Af. Mus. = *Annals of the South African Museum* (Edinburgh).
Anthropos. = *Anthropos, Internationale Zeitschrift für Völker- und Sprachenkunde*, Wien.
Antiq. = *Antiquity*, A Quarterly Review of Archaeology, Gloucester.
Anz. phil.-hist. Kl. Ak. Wiss. Wien. = *Anzeiger der philos.-hist. Klasse der Akademie der Wissenschaften in Wien.*
Arch. J. = *The Archaeological Journal.*
Arch. I. P. h. = *Archives de l'Institut de Paléontologie humaine*, Paris.
Arch. Antr. e Etn. = *Archivio per l'Antropologia e la Etnologia*, Firenze.
Arch. zool. ital. = *Archivio zoologico italiano*, Padova.
Ass. fr. av. Sc. = *Association française pour l'avancement des Sciences* (Comptes rendus).
Bibl. = *Biblica.*
Biom. = *Biometrika*, a Journal for the Statistical Study of Biological Problems, Cambridge.
B. S. A. Eg. = *British School of Archaeology in Egypt* (various publications).
B. A. S. P. R. = *Bulletin of the American School of Prehistoric Research*, New Haven, Conn.
Bull. Ass. Géogr. franç. = *Bulletin de l'Association des Géographes français*, Paris.
B. C. É. A. O. F. = *Bulletin du Comité d'Études historiques et scientifiques de l'Afrique Occidentale Française* (Paris, Larose Éditeurs).
B. F. A., Un. Eg. = *Bulletin of the Faculty of Arts, University of Egypt* (now *Fuad I University*), Cairo.
Bull. Geol. Inst. Uppsala. = *Bulletin of the Geological Institute of Uppsala.*
Bull. Geol. Soc. Amer. = *Bulletin of the Geological Society of America.*
Bull. Geol. Soc. Ch. = *Bulletin of the Geological Society of China*, Peiping.
B. I. Ég. = *Bulletin de l'Institut d'Égypte*, Le Caire.
B. I. fr. A. or. = *Bulletin de l'Institut français d'Archéologie orientale*, Le Caire.
Bull. Mus. Nat. Hist. Nat. = *Bulletin du Museum National d'Histoire Naturelle*, Paris.
Bull. Serv. géol. Pol. = *Bulletin du Service géologique de la Pologne*, Varsovie (Sprawozdan Polskiego Instytutu Geologicznego, Warszawa).
Bull. Soc. Anthr. Paris. = *Bulletins et Mémoires de la Société d'Anthropologie de Paris.*
Bull. Soc. Géogr. Arch. Oran. = *Bull. de la Société de Géographie et d'Archéologie d'Oran.*
Bull. Soc. géol. Fr. = *Bulletin de la Société géologique de France*, Paris.
Bull. Soc. Hist. nat. Af. du N. = *Bulletin de la Soc. d'Hist. naturelle de l'Afrique du Nord*, Alger.
B. S. P. f. = *Bulletin de la Société Préhistorique française*, Paris.
B. S. R. Géogr. Ég. = *Bulletin de la Société Royale de Géographie d'Égypte*, Le Caire.
C. R. Ac. Sc. = *Comptes rendus de l'Académie des Sciences*, Paris (*a* = 1er semestre; *b* = 2e semestre).
C. R. Cong. Intern. Géogr., Le Caire 1925, Paris 1931 Varsovie 1934 et Amsterdam 1938. = *Comptes rendus du Congrès International de Géographie*, Le Caire 1925 (4 tomes pub. 1926), Paris 1931 (3 tomes pub. 1932-4), Varsovie 1934 (4 tomes pub. 1936-38) et Amsterdam 1938 (Actes et Rapports, t. I et II, 1938).

C. R. Cong. Intern. Sc. anthr. ethn. = *Comptes rendus du Congrès International des Sciences anthropologiques et ethnographiques; Compte rendu de la 1re Session*, London 1934 *Compte rendu de la 2e Session*, Copenhagen 1938 (pub. 1939).
C. R. Soc. géol. Fr. = *Compte rendu sommaire des Séances de la Société géologique de France*, Paris.
Denkschr. Ak. Wiss. Wien, Phil.-hist. Kl. = *Denkschriften* (*der kaiserlichen*) *Akademie der Wissenschaften in Wien, Philosophisch-historische Klasse.*
Eisz. u. Urg. = *Eiszeit und Urgeschichte; Jahrbuch für Erforschung des vorgeschichtlichen Menschen und seines Zeitalters*, Leipzig (K.W. Hiersemann).
G. J. = *The Geographical Journal* (Royal Geographical Society, London).
G. R. = *The Geographical Review* (Journal of the American Geographical Society, New York).
Geogr. Abh. = *Geographische Abhandlungen* (Wien und Olmutz, Ed. Holzel).
Geogr. Zeitschr. = *Geographische Zeitschrift.*
Geogr. Ann. = *Geografiska Annaler*, Stockholm.
Geol. Mag. = *The Geological Magazine* (London).
(*Geol.*) *Surv. Dept. Eg.* = (*Geological*) *Survey Department of Egypt*, Cairo (Reports and Memoirs).
Gior. di Geol. = *Giornale di Geologia* (Annali del Reale Museo geologico di Bologna).
Ipek. = *Ipek, Jahrbuch für Prähistorische und Ethnographische Kunst*, Leipzig.
Jahrb. Preuss. Geol. Landesan. = *Jahrbuch der Preussischen Geologischen Landesanstalt* (Berlin).
J. E. A. = *Journal of Egyptian Archaeology.*
J. E. Af. and Uganda Nat. Hist. Soc. = *Journal of the East Africa and Uganda Natural History Society.*
J. P. O. S. = *Journal of the Palestine Oriental Society*, Jerusalem.
J. (R.) A. I. = *Journal of the* (*Royal*) *Anthropological Institute of Great Britain and Ireland*, London.
J. Soc. Af. = *Journal de la Société des Africanistes*, Paris.
L'Anthr. = *L'Anthropologie* (Paris).
La Géogr. = *La Géographie* (Société de Géographie, Paris).
Liverp. Ann. = *Liverpool Annals of Archaeology and Anthropology.*
Man = *Man, A Monthly Record of Anthropological Science*, London.
Mem. Geol. Serv. China. = *Geological Memoirs* (continuation of the Memoirs of the Geological Survey of China, to be quoted as the Mem. Geol. Serv. China), Peiping.
Mém. Soc. géol. Fr. = *Mémoires de la Société géologique de France*, Paris.
Mitt. D. I. Ä. A. Kairo. = *Mitteilungen des Deutschen Instituts für ägyptische Altertumskunde in Kairo* (Wien).
Mitt. Geogr. Ges. München = *Mitteilungen der Geographischen Geselschaft in München.*
Or. Inst. Com. = *The Oriental Institute of Chicago University, Communications.*
Or. Inst. Pub. = *The Oriental Institute of Chicago University, Publications.*
Peters. Mitt. = *Petermanns Mitteilungen.*

P. Z. = *Prähistorische Zeitschrift.*

1er, 2e ou 3e Rap. Com. Terr. plio. et pléis. (U. G. I.). = *Premier, deuxième ou troisième Rapport de la Commission des Terrasses pliocènes et pléistocènes.* Union géographique Internationale (sous la rédaction de K. S. Sandford, 1928, 1930 et 1933).

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P. C. É. A. O. F. = *Publications du Comité d'Études historiques et scientifiques de l'Afrique Occidentale Française* (Paris, Larose Éditeurs).

Quartär = *Quartär;* Jahrbuch für Erforschung des Eiszeitalters und seiner Kulturen; herausgegeben von R. Grahmann und L. F. Zotz, Berlin (1938 etc.).

Q. J. G. S. = *The Quarterly Journal of the Geological Society*, London.

Q. J. R. Met. Soc. = *Quarterly Journal of the Royal Meteorological Society*, London.

Q. S., P. E. F. — *Quarterly Statement, Palestine Exploration Fund.*

Reall. d. Vorg.=*Reallexikon der Vorgeschichte*, unter Mitwirkung zahlreicher Fachgelehrter, herausgegeben von Max Ebert, Berlin 1924-1929.

R. Soc. arch. Cons. = *Recueil des Notices et Mémoires de la Société archéologique (historique et géographique) du Département de Constantine*, Constantine.

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Rev. Géogr. phys. et Géol. dyn.=*Revue de Géographie physique et de Géologie dynamique* (Paris).

Rev. sc. = *Revue scientifique*, Paris.

Scot. Geogr. Mag. = *The Scottish Geographical Magazine*, Edinburgh.

Sitz.-ber. preuss. Ak. d. Wiss., phys.-math. Kl. = *Sitzungsberichte : preussische Akademie der Wissenschaften; physisch-mathematische Klasse* (Berlin).

Sitz.-ber. preuss. Geol. Landesan. = *Sitzungsberichten der preussischen Geologischen Landesanstalt.*

Sud. Not. Rec. = *Sudan Notes and Records.*

Surv. Dept. Eg. = *Survey Department of Egypt*, Cairo (Reports and Memoirs).

Syr. = *Syria*, Paris.

Trans. Geol. Soc. S. Af. = *Transactions of the Geological Society of South Africa.*

Trans. Roy. Soc. S. Af. = *Transactions of the Royal Society of South Africa*, Cape Town.

W. P. Z. = *Wiener Prähistorische Zeitschrift, Herausgegeben von der Wiener Prähistorische Gesellschaft*, Wien.

Z. äg. Spr. = *Zeitschrift für ägyptische Sprache* (u. s. w.), Leipzig.

Z. Deutsch. Geol. Ges. = *Zeitschrift der Deutschen Geologischen Gesellschaft.*

Z. Dtsch. Paläst.-Ver. = *Zeitschrift des Deutschen Palästina-Vereins*, Leipzig.

Z. f. Ethn. = *Zeitschrift für Ethnologie.*

Z. Ges. f. Erdkde Berlin. = *Zeitschrift der Gesellschaft für Erdkunde zu Berlin.*

Z. f. Gletschkde. = *Zeitschrift für Gletscherkunde, für Eiszeitforschung und Geschichte des Klimas* (Leipzig, Verlag von Gebrüder Borntræger).

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